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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 2000

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

HOUSE OF REPRESENTATIVES

ONE HUNDRED SIXTH CONGRESS
FIRST SESSION

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PART 1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 2000

Tuesday, March 23, 1999.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WITNESSES

DANIEL S. GOLDIN, ADMINISTRATOR
LEE HOLCOMB, CHIEF INFORMATION OFFICER
ARNOLD G. HOLZ, CHIEF FINANCIAL OFFICER
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ROBERTA GROSS, INSPECTOR GENERAL
GHASSEM ASRAR, ASSOCIATE ADMINISTRATOR FOR EARTH SCIENCE

Chairman's Opening Remarks

Mr. Walsh. The hearing will come to order.

This morning we would like to welcome Daniel Goldin, Administrator of the National Aeronautics and Space Administration for the committee's hearing on the NASA budget for fiscal year 2000. I would also welcome my colleague, Mr. Mollohan.

The NASA budget request is about $13.6 billion, approximately $100 million below the appropriation for fiscal year 1999. Major components of the funding request for fiscal year 2000 include $2.5 billion for the International Space Station, development and assembly, $3 billion for shuttle operations, $2.2 billion for space science, 1.4 billion for Earth sciences. It is noteworthy that the area of your budget which has the largest change compared to fiscal year 1999 is the aeronautics program and that change is 33 percent reduction.

At the risk of suggesting some humor, some persons have suggested as a result that the name of the agency should be changed to the National Space Administration given the decreasing role of aeronautics in your mission. We look forward to your explanation about the changes in all your programs and the aeronautics program in particular.

Mr. Goldin, your entire statement will be made a part of the record of this hearing. I would like you to summarize your statement. Before you begin, I would like to ask Mr. Mollohan if he has any opening statement?

[The statement of Mr. Goldin follows:]

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

Opening Remarks of Congressman Mollohan

Mr. Mollohan. I would also welcome Administrator Goldin and

compliment him on the good job he is doing at the National Aeronautics and Space Administration, and I look forward to hearing how he is setting NASA's priorities for the future. We recognize how difficult this task is under the current budgetary restraints and look forward to working with him to try to fund his priorities and move the space program on.

Thank you, Mr. Chairman. Welcome.

Mr. Walsh. Thank you, Alan. I second those positive comments about your administration. It is a difficult budgetary time. No one knows more about that than you and your people, and you have been very successful given those constraints. The highest priority project seems to be the Space Station, but why don't you let us tell us what you have been doing.

Administrator Goldin's Opening Remarks

Mr. Goldin. Good morning, Mr. Chairman and members of the committee. I am pleased to appear before you today and present the President's budget request for Fiscal Year 2000. For the first time in many years, NASA has a projected outyear budget that is higher than the budget year request, thanks in great part to the efforts of this subcommittee.

Funding has been added for the International Space Station, space science and future launch. I am gratified by the Administration's alignment of NASA's priority with theoutyear budget. Nonetheless, the request of approximately $13.6 billion for the fiscal year 2000 budget is very lean. It is below the fiscal year 1999 enacted levels, and in fact continues a trend for the last 6 years where the NASA budget has come down, and I will submit this chart for the record. And it is so tightly constructed that there are several areas where concerns have been raised by a number of members. I look forward to beginning a dialogue with the subcommittee today regarding this budget proposal. Mr. Chairman, we are proud of our accomplishments and confident about the future.

Last year a new star appeared on the horizon of the International Space Station. When complete, this research center in space will include over a hundred major pieces of hardware from 16 countries, delivered by 6 different vehicles from 4 launch complexes around the world. It will create new opportunities for long term research, such as the growth and study of cellular structures, including living tissue and protein crystals.

Our vibrant space science program is producing fantastic results as we keep driving down mission costs. We are in the middle of an intense launch period of 10 launches in 9 months. In fact in one more year the space science budget will exceed that of the Space Station alone. We are on track to conduct an expedited servicing mission for the Hubble Space Telescope to ensure that its outstanding science remains uninterrupted. This budget supports the next generation's space telescope which will build on Hubble's marvelous results and it will cost about one fifth of what Hubble cost, be about 3 times bigger and 10 times more powerful. We want to establish a virtual presence throughout our solar system. We will have fleets of small spacecraft, rovers and probes in orbit around various planets and moons in their atmosphere on their surfaces and burrowing underneath. We will need an interplanetary Internet to assemble

and send back to Earth the tremendous amount of information that will be generated by these robot emissaries. The first step of this Internet at Mars is in this year's budget. Our Earth Science program is experiencing its most ambitious year ever with almost a launch a month for the rest of the year. Our research will give us different views of the Earth, water vapor, the biosphere, global cloud cover, ocean temperature, and crustal dynamics. Collectively, these views will teach us how the Earth works as a system. By integrating detailed measurements at the global, regional and local levels, and combining them with predictive modeling, we hope to be able to understand and predict weather and climate on a seasonal annual, and ultimately decadel basis.

Commercial applications of remote sensing will continue to grow exponentially, including agriculture, urban planning, disaster mitigation, environmental compliance, highway and pipeline siting and resource management. NASA continues to push the frontiers of flight from general aviation to space access. We are developing synthetic vision so pilots will be able to see the landscape, no matter what the weather, day or night, decreasing the likelihood of accidents. We will push revolutionary aeronautics concepts through the X planes and develop new engine technology in high temperature materials and combustion to lower fuel consumption and improve performance.

We are looking to the future, when there will no longer be a distinction between air and space travel. The revolutionary reusable launch vehicle program is demonstrating technologies that could dramatically reduce the cost of launching a payload to orbit--from today's roughly $10,000 per pound to $1,000 per pound--while at the same time improving safety by a factor of 10.

This budget continues our space transportation architecture studies, to develop an investment strategy for reducing our cost of access to space by using commercial capabilities. We also have $10 million for next decade planning to ensure an appropriate vision for the future that integrates robotic and human exploration.

Our plans for the future will require revolutionary approaches, such as Intelligent Synthesis Environment (ISE). ISE will enable geographically dispersed scientists and engineers to work as a team in a totally immersive, controlled real time virtual environment for end-to-end spacecraft design, development, test, manufacturing and operation. This will lower costs, accelerate development time, and increase mission success.

Because NASA doesn't think small, because we plan for the long term, not the short term, this budget is not designed for the next decade. It is an investment in the next millennium, and NASA is proud to lead the way.

I would be pleased to respond to questions from you, Mr. Chairman and Members of the subcommittee.

RUSSIAN EQUIPMENT AND HARDWARE DELAYS

Mr. Walsh. Thank you very much. I will begin on the Space Station. As a result of Russian equipment and hardware delays, the United States has had to make a significant investment in

alternative hardware to compensate for potential Russian nonperformance. Two of those items are the interim control module and the U.S. propulsion module. Assuming that the Russians are not able to complete the service module, when does NASA have to baseline the interim control module for launch as a replacement for the service module in order to launch the Interim Control Module in 1999?

Mr. Goldin. We are carrying two configurations for the Interim Control Module. One, if the service module is not up there and, second, as a backup to the propulsion on the service module. Late this spring we will have to start doing the planning for the Shuttle, and by this fall of 1999 we are going to have to make a decision on which configuration we are going to have for the Interim Control Module.

Mr. Walsh. What is the total cost of the Interim Control Module?

Mr. Goldin. $156 million.

Mr. Walsh. Will the U.S. propulsion module be launched regardless of whether the service module is in orbit?

Mr. Goldin. Yes. We believe that it is the right thing to do to launch the U.S. propulsion module. We will have a very large investment on orbit. We will have equipment from many different countries. It makes the system much more robust having the U.S. propulsion capability on orbit. It also will allow us to ensure that even if the service module is launched, that the Russians have problems in delivering propellant to the International Space Station, we could keep the station up in orbit with the proper attitude, and the cost is at the present time estimated at about $500 million. We will be having a preliminary design review this fall, at which time we will have a final number, but I believe it will be somewhere around $500 million, and this year's President's budget covers the full cost of this module.

SPACE STATION BUILDING COST

Mr. Walsh. The current estimate for building the Space Station is 23.4 billion to 26 billion, which is 6 to 8.6 billion over your estimate of 17.4. How much of this overrunis due to the growth of requirements and how much is due to Russian nonperformance?

Mr. Goldin. First, let me say that our estimate for the Space Station at development complete is between $22 and $24 billion, and the reason we say that is we will have the lion's share of the research capability going on at that point in time. There is significant overrun. Some would say that the overrun is completely due to the Russians. I do not believe that is the case. I would say a large share of that is due to the Russians in their inability to deliver the hardware that we need.

A significant amount of requirements growth has occurred, about a billion dollars to just build additional equipment in the United States to back up capabilities of the Russians and then another billion dollars is associated with our decision to build a crew return vehicle. Based on experience that we had on Shuttle-Mir, we felt that it would be necessary to have a crew return vehicle capable of taking 7 astronauts back from space.

The Soyuz vehicle is only capable of taking 3, and we felt that it would be necessary to have 2 of these crew return vehicles onboard. So I would say a few billion dollars of the cost growth is due to these increased requirements. A significant portion of the remainder is due to the problems we are having with the Russians and growth due to our own contractors.

SPACE STATION COST OVERRUNS

Mr. Walsh. So that would put the Russians' responsibility for overruns in the $4 to $6 billion category?

Mr. Goldin. I wouldn't say that it is that much. We have some growth at our contractors. For the record, we would be happy to give you the exact numbers, but my recollection is that the cost growth at Boeing is about a billion dollars and internal to NASA is about a half million to $700 billion.

Mr. Walsh. That is attributable to the Russians?

Mr. Goldin. Not attributable. So the remainder of the number is attributable.

Mr. Walsh. So it is a substantial amount of money?

Mr. Goldin. Yes.

SPACE STATION SCHEDULE SLIPPAGE

Mr. Walsh. How about slippage in the schedule?

Mr. Goldin. Schedule slippage is part of the issue that we have in terms of delays from the Russians. I don't have all of the numbers clearly in my head, but we can submit for the record the breakout of those numbers.

[The information follows:]

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

RUSSIAN SPACE AGENCY BUDGET

Mr. Walsh. In 1998, the Russian Space Agency budget was 600.2 million, of which it received 187 million from the Russian government and another 60 million from the U.S. Last year NASA estimated that the Russian Space Agency needed about 300 million in 1999 to meet ISS obligations, of which NASA proposed to provide 150 million. In your estimate of the Russian Space Agency's funding requirements, are those figures still accurate?

Mr. Goldin. I don't know. The major problem we have in determining how much the Russians need is our ability to convert Russian rubles, which is what the budget is appropriated in, into dollars. And given the variability of the exchange rate of rubles to dollars, A and B, the real effect of usage of rubles in Russia is very hard for us to estimate it. That is one of the dilemmas we have.

Secondly, that $300 million number assumed that the Russians were going to build the science power platform and research modules unique to them and right now their decision is to build the hardware that is only essential to keep the Space Station going. So they have pulled back on some of their own needs and prioritized the needs that allow everyone else to

proceed. So it is very hard for us to explain that, and that is the best explanation I can give.

So far I can say that on the things that they promised to do this year they have been performing and in fact the service module is almost ready to be packed up and shipped to the Baikonur Cosmodrome. They are within a few weeks of being able to pack it up and ship it to the Cosmodrome.

I don't know how to answer the question more specifically than that.

RUSSIANS AS A FULL PARTNER

Mr. Walsh. We started out with the Russians as a full partner where they get equal flight time and use of the labs and so forth. Are they fulfilling their role as a full partner or are they just like a subcontractor now?

Mr. Goldin. No, at this point in time they still are a full partner. If they deliver that service module in roughly the time frame that they are supposed to--there are 3 things that we are expecting from the Russians. We would like that service module delivered on orbit in the fall of this year. We would like them to be able to produce three Progress per year and deliver them to orbit and two Soyuz per year and deliver them to orbit. That is absolutely crucial to us, and we would also expect that the Mir Space Station will be deorbited unless they can get funds outside of the Russian Space Agency to operate that Mir Space Station. These are the three things that we believe are essential to the Russians meeting their obligations to the International Space Station. And if they do that, they will be considered full partners. Up to the present time we have purchased specific goods and services from the Russian Space Agency and we have not in any way subsidized them.

Mr. Walsh. Would you like me to yield?

DEORBITING PLAN

Mr. Frelinghuysen. Thank you. What does that mean? Translate that statement into English. When you were here last, you said that there would be a plan by July, didn't you? A deorbiting plan?

Mr. Goldin. We have such a deorbiting plan on the Mir.We have a document from the Russians which said that in August of this year the Mir station would be deorbited. They indicated that there are some private investors that were interested in having a private operation of the Mir Space Station. We told the Russians that they are a sovereign nation. It is not for us to tell them what they should do with their resources as long as they pay their bills on the International Space Station.

Mr. Frelinghuysen. Thank you.

INTERIM CONTROL MODULE

Mr. Walsh. On this interim control module issue, you said late fall for a final configuration?

Mr. Goldin. Yes.

Mr. Walsh. If that is the case, what is the earliest time you can get that into orbit?

Mr. Goldin. The spring of 2000. That is governed by the fact that the FGB has electronics that have been certified for about a year and a half. And if we do not have the service module on orbit to protect the FGB and the unity node that we have up there, we would have to launch the ICM by the spring of 2000 to keep continuity on orbit.

SERVICE MODULE

Mr. Walsh. What does that do to the schedule?

Mr. Goldin. That would be a major slip to the schedule. It will slip the time at which we would have human presence. If we have the service module on orbit in the fall of this year, we anticipate that we will have permanent human presence onboard the Space Station by early 2000.

If they do not launch the service module, we would not have human presence for a year or two after that. I want to come back and say at the present time the testing is almost complete on the service module; 500 of 570 tests are complete. The plan is to pack and ship the service module to Baikonur and I believe the date at which it is due to arrive at Baikonur is May 7.

Mr. Walsh. Will those additional tests be conducted at Baikonur?

Mr. Goldin. I am sorry, I don't understand the question.

Mr. Walsh. You said 500 of 570 tests.

Mr. Goldin. There are 70 tests missing because of 4,030 pieces of hardware; 36 pieces of hardware will be shipped to Baikonur to be integrated down there. So they couldn't perform the remaining 70 tests, and those tests will be done down at Baikonur.

Mr. Walsh. When you say 500 tests have been completed, does that mean that they have been completed successfully or adjustments have been made to make them successful?

Mr. Goldin. I believe the tests have been successfully completed, but I can check the data when I have a break and I can answer that more specifically.

PURCHASE OF GOODS AND SERVICES FROM RUSSIA

Mr. Walsh. You have indicated that NASA intends to request another 100 million to be sent to Russia in April of 1999. What specifically does NASA plan to buy for that $100 million, and how much will each item cost?

Mr. Goldin. The most important item that we intend to buy is a Soyuz vehicle. We have a very, very tight schedule for building the crew return vehicle. It will be the first new piloted vehicle that the United States has developed in over 25 years.

But we would like to start six-person operation on board the Space Station as soon as possible. The Chabrow panel had recommended to us in their review of the Space Station that we consider buying an insurance policy by having one or two extra Soyuz vehicles in advance. So we have prenegotiated a price but we have not committed to buying it. We believe that price would be about $65 million to get the Soyuz vehicle.

Other things we are considering is we would like to buy

some simulators for our training of our crews for the service module and FGB that we could use in the zero gravity facility down in Houston. There are a number of other specific pieces of hardware: A Russian virtual reality trainer, ORLAN maneuvering unit, equivalent to the U.S. SAFER.

Mr. Walsh. Rather than going through the whole list, this number, a hundred million, is that a number you just plug to the Russian Space Agency in order for it to continue operation? To keep them gainfully employed?

Mr. Goldin. We had made an estimate last year and that was the $300 million estimate you referred to, we anticipated that they would get about $150 million equivalent in funding from the Russian Space Agency and that--we had needs for specific pieces of hardware which tallied up to about $100 million. In fiscal year 1999, we sent them $60 million to buy specific items that was a benefit to us. We got an initial 4,000 hours of crew time and we got storage space. We bought those items that we needed, but on the other hand had we not bought those services, we think that the activity on the service module would have ground to a halt. So it is a combination of the two.

Mr. Walsh. Thank you. Mr. Mollohan.

Mr. Mollohan. Thank you, Mr. Chairman. Mr. Goldin, welcome to the hearing.

Following up on the chairman's line of questioning, you were itemizing what necessary components to the International Space Station Russia is providing, and you started listing a number of components. Are they critical path components that you are purchasing?

Mr. Goldin. These components would allow us to do--where is that piece of paper that I had?

Mr. Mollohan. Are these 1999 purchases that you are talking about or are they projected for 2000?

Mr. Goldin. 1999. No, there is no money in the budget beyond 1999 to purchase specific goods and services from the Russians. Last year as part of the planning process we had looked at the possibility of including in the budget request for fiscal year 2000 $150 million a year for 4 years to buy specific goods and services from the Russians.

On reflection, during the preparation of the fiscal year 2000 budget, we made a decision that it would demotivate the Russian government from paying the bills to the Russian Space Agency if we had a line item in our budget of $150 million a year. So as part of the process with the administration, we decided that we would not request $150 million a year over a 4-year period because we felt it was very important that the Russian government meet its commitment to the Russian Space Agency.

I might say here that the Russian Space Agency has performed very, very well and whenever they have been funded, they have done terrific work. So we wanted to motivate the Russian government to pay the Russian Space Agency the dollars that they appropriate for them. The dilemma we have is the dollars get appropriated, but they don't get funded, and that causes a tremendous problem in planning for us which causes the cost growth that we talked about earlier.

CRITICAL PATH ITEMS

Mr. Mollohan. Are the goods and services that you arepurchasing in 1999 critical path items? What would be the impact of failures of delivery?

Mr. Goldin. Well, we believe the purchase of a Soyuz vehicle is really an essential element. It will allow us to do much more research. If the crew return vehicle is not available, we will only have to limit the total number of astronauts to three. At that point in time we will have 17 racks available of research space on the Space Station. There will be an additional 5 racks in the Japanese experimental module of which the U.S. is entitled to 50 percent. We will have a whole series of express racks, so we feel that it would be a tremendous loss of research capability if we didn't have the insurance policy of having this extra Soyuz vehicle.

Secondly, the Russians having the hard cash from this Soyuz vehicle allows them to keep their labor force engaged, so I want to be sure that it is clear. We are getting specific things that we want, but it also provides a certain level of stability in 1999 to keep the program going when we are going through the most critical phase. We want that service module on orbit. We could have significant delays measured in years and cost growth measured in a very large number if we don't have it. So it is for those reasons that we feel strongly that we should have the flexibility to buy that Soyuz vehicle should we need it.

Secondly, there is a list of other items that we are interested in.

Mr. Mollohan. Is the Soyuz included in the hundred million figure?

Mr. Goldin. Yes, it is 65 of the hundred million. And then there are 35 million of other things that will help our training and reduce our costs. We could buy things in Russia at a much lower value than it would cost us to do it in the United States, so we think that it would be in the interest of the program to do those things.

But at the end of 1999, we have no planned money in the budget for any further purchases of goods and services. We will just have to monitor the situation and take appropriate steps in the future. But we feel strongly that to put money in our budget from 2000 to 2003 would disincentivize the Russian government to pay the bills.

Service Module

Mr. Mollohan. Do you think the continuing problem with the service module, that is to say the lack of resources coming down to the Russian Space Agency, been solved? Or do you anticipate it continuing?

Mr. Goldin. We believe that we are over the worst of our problems with the service module. There has been unbelievable progress on the service module since we purchased additional crew time for that $60 million, and they are almost finished testing the service module. The hardware that is supposed to be shipped to Baikonur is almost ready to be shipped and the Russians have demonstrated to us with the Spektr and Priroda modules earlier in the Mir program that they can process

equipment at Baikonur in about 4 months and have it ready for launch.

Some of our people think that it will take another month or two, but we believe that we are on a path to get the service module on orbit in the fall.

Funds from Russian Government to the Space Agency

Mr. Mollohan. What is the situation with funds flowing from the Russian government to the Russian Space Agency?

Mr. Goldin. It is inconsistent. The Russians, as you know, have----

Mr. Mollohan. Is it improving?

Mr. Goldin. This year for January, February and March, the Russian Space Agency has received their allocated funding from the Russian government. This is something that is a very positive sign, but generally we see the problems occurring in the April to August time frame, so it will be very important to us this year to see whether the funding will come from the Russian government in that time frame.

Service Module Launch

Mr. Mollohan. When do you expect the service module to be launched?

Mr. Goldin. The Russians have told us that they are still planning on launching it September 20. Our people think that they could be 1 to 2 months later than that.

Mr. Mollohan. What are the consequences?

Mr. Goldin. We could accommodate the 1 to 2-month slip and keep the program on track. If it goes beyond the 1 or 2-month slip, we will have cost impact and schedule impact to the program.

Russian Program Assurance Money

Mr. Mollohan. What is the Russian program assurance money $200 million being used for?

Mr. Goldin. $156 million is for the Interim Control Module (ICM). The remainder is to buy specific goods and services. Like we had them modify the docking adaptor on the FGB to accommodate some of our equipment. That allows us to keep the program going in the event that they don't perform.

Boeing Contract Overruns

Mr. Mollohan. You indicated in answers to the Chairman that part of the billion dollars in overrun cost are attributable to Boeing's contract. How much of that overrun do you attribute to Boeing?

Mr. Goldin. Right now I think the exact number is $783 million. I round it up to the nearest billion dollars. But the exact number that Boeing is carrying is $783 million.

Mr. Mollohan. What are you doing about that? How are you dealing with it?

Mr. Goldin. Boeing's award fee was impacted by it.

Mr. Mollohan. In what way?

Mr. Goldin. One time they got zero award fee.

Mr. Mollohan. That was a couple of years ago, wasn't it?

Mr. Goldin. And they have performed pretty well since then. This is a very tough program. Boeing on average has been a good contractor. Boeing, like NASA, had not participated in a major program like this in over 20 years. There were some very significant startup problems. But after we got over the problems a year or two ago, Boeing has been performing very, very well.

Mr. Mollohan. So the overruns are past history?

Mr. Goldin. Yes. That is correct.

Space Station Amendment

Mr. Mollohan. A final question, Mr. Chairman, on this round.

When we go to the floor every year, there is usually an amendment to knock out the Station. While I have certainly supported the ISS and we have always defeated the amendment, I want to give you the chance to add something.

Mr. Goldin. No, not at all.

Mr. Mollohan. I would like to give you an opportunity to help us make the case to defeat an amendment to remove the Station program from the budget; and perhaps you can comment on it now and then follow up with a submission for the record.

Mr. Goldin. I would be pleased to give a summary and we will follow up for the record. The International Space Station program in my mind is one of the most difficult things that this government has ever undertook. Clearly theManhattan Project and the development of the ballistic missiles was much, much tougher at the time it was undertaken.

But other than those two programs, I know of no more difficult program due to the international interaction we have. We have 16 nations working on this program. We are going to have a hundred launches from six different launch vehicles from four different launch complexes.

This vehicle is bigger than the U.S. Capitol. It is 200 miles above the ground. The first two pieces of equipment that we sent up there weighed tens of thousands of pounds and they were built 10,000 miles apart. They never were preintegrated. The first place they got integrated was on orbit. This has never been done before, and we only did it with some tens of hours of assembly time on orbit. In my mind that is a spectacular success, and it is testimony to the outstanding job this team has done.

We have had some problems, but in the big picture these problems have been very well managed and in fact an outside panel has complimented NASA for doing a very sound job.

This Space Station is essential if we are ever to leave Earth orbit, which we will do as a society. We must understand how people could live and work in space and we must understand how to develop countermeasures to counter the debilitating effects that occur to people both physically and psychologically. We must learn how to integrate robots and people. We must learn how to develop telemedicine and medical approaches so that if people are traveling 25,000 miles an hour and 50 million miles from Earth and if they get sick, we can do

that in real time because they cannot go to a hospital.

We are going to develop communications technologies that will be unbelievable. On Earth we communicate over tens of thousands of miles. We will be communicating over hundreds of millions of miles. The time delay is 20 to 40 minutes at the speed of light to communicate with these people. During Apollo we had tens of thousands of people on the ground to operate this system. The system will have to have an intelligence in and of itself. There is more computing power in your car today than we had on Apollo 11. We will be developing intelligence systems that will have enormous impact on the ground, based upon doing such a mission. We will have to be able to assemble millions of pounds in orbit. This is what is going to be necessary and without this Space Station we will never ever do it. And the issue is do we have a vision that this society is going to boldly lead the world in the 21st century or is it not. The Space Station is a litmus test of that activity.

[The information follows:]

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

Mr. Mollohan. Thank you. Thank you, Mr. Chairman.

Mr. Walsh. Thank you, Alan. Mr. Frelinghuysen.

Savings Due to Russian Involvement

Mr. Frelinghuysen. Good morning, Mr. Goldin.

Last year the new chairman, Mr. Walsh, made a few remarks on the record and I was looking it over and I would like to quote from him and your reaction.

``On the Space Station now the Clinton administration invited the Russians to join the Space Station back in, I believe it was, 1993 and their participation was justified by the claim that the American taxpayers would save over $2 billion with that partnership. Now two hardware delays in Russia and the cost of the Space Station have risen by over $2 billion, and as my colleague from New Jersey pointed out,'' he is referring to me, ``there is some expectation it could be an additional 2 billion for an increase of 4 billion. Have all of those savings that we were told about evaporated?'' This is Mr. Walsh's question.

Where do we stand now in 1999 because your answer last year was, ``At the present time, the Russian delays in funding to their space agency have caused significant cost impact to the United States. If this continues, we will use up that $2 billion in savings we had in the development phase.''

Where do we stand now?

Mr. Goldin. I believe that we will not see a savings with the presence of the Russians.

But let me come back and remind you one of the main reasons we wanted the Russians in the program. The Vest panel led by President Vest of MIT indicated it was essential to have dual access to space. The Russians have the Proton, the Soyuz and the Progress vehicles. We will have a very expensive asset on orbit. We have had a circumstance where the Shuttle was down for a couple of years when we had a problem. Having the backup

of those Russian vehicles we believe is still essential today, as it was when we started the program.

Clearly we are very disappointed that because of the Russian economy we have not achieved the savings we wanted to achieve. I might point out during the Cold War the Russian GDP was about half that of the United States and today it is about 1/22nd. There is a very significant economic problem in Russian. This is something that we cannot control.

Deorbiting the Mir

Mr. Frelinghuysen. How much money will you save by deorbiting the Mir?

Mr. Goldin. It is not a question of saving money. We believe the Russian government, unless they deorbit----

Mr. Frelinghuysen. We want to go ahead with the Space Station. We have our partners. You have a plan for deorbiting the Mir. It is a little unclear to me when that plan takes effect.

Mr. Goldin. August.

Mr. Frelinghuysen. From that point to what point, and for how long will it take to bring the Mir down? Isn't that what we are talking about by deorbiting?

Mr. Goldin. We believe it will come down in August.

Mr. Frelinghuysen. Will there be savings by bringing it down, which means that we can make more investment in the International Space Station?

Mr. Goldin. The Russians we don't believe can afford to have the Mir on orbit and fund the International Space Station given the budget conditions they have.

Mr. Frelinghuysen. With all due respect to their budget considerations, what are our budget considerations if the Mir comes down? What do we save on an annual basis? We are presently investing in our partnership with the Mir?

Mr. Goldin. We are not paying any money into the Mir Space Station. We are done. When the last Shuttle went up to the Mir, we are not spending any money on the Mir Space Station. The amount of dollars that we are spending on Mir at the present time is zero. So it is not a question of any money coming out of the U.S. budget to keep Mir in the sky.

Mr. Frelinghuysen. How much will the Russians be saving?

Mr. Goldin. My estimate is something on the order of $50 to $100 million equivalent per year. But they don't have that money and it is essential that if they don't have any private sources paying to keep Mir in the air, Mir has to come down. We have made that very clear to them. The International Space Station has to be their number one priority. And by April they said if they do not have private financing to keep the Mir up in the sky, it will come down in August as they have promised.

Russian Partners

Mr. Frelinghuysen. The public perception, and to a certain extent we represent the public, is that we are often forgiving of our Russian partners. We talked about this last year and you tried to sort of correct the record in saying that there were good reasons why we need to be supportive of Russian, but for

those of us who serve on other appropriations committees, we are looking after their nuclear stockpile to a certain extent and for good reason. We are helping them with their nuclear reactors to the extent that we can in terms of clean up and decommissioning. We are hiring their scientists, perhaps for good reason, like 7,000 of them, and I am told that they have 70,000 that deal with nuclear weapons. We make a substantial commitment to Russian. How many people are there in the Russian space program, employees?

Mr. Goldin. Tens of thousands.

Mr. Frelinghuysen. 50 thousand, 60,000?

Mr. Goldin. We have heard numbers that range between 50,000 and 70,000.

Mr. Frelinghuysen. And what is our relationship with these people? Have we hired any of these people?

Mr. Goldin. No.

Mr. Frelinghuysen. Do we know what the ultimate disposition of this workforce is? Are they all employed or are they potentially out there for the picking by our potential adversaries?

Mr. Goldin. Let me see if I can answer it this way. I want to come back to what I said. During the Cold War when we were adversaries, the Russian GDP was about 50 percent of the United States. It is now 1/22nds of the United States. It is very chaotic in Russia. People in the United States take for granted getting a paycheck. Sometimes the Russian people do not get paid for 2 or 3 or 4 months.

Mr. Frelinghuysen. My question is are there ways that we are taking advantage of this knowledge and their technology?

Mr. Goldin. We are relying upon their Progress, Soyuz and Proton rockets as backup to maintain the Space Station up in the orbit. We have had an incredible learning from the Shuttle-Mir experience that has caused us to redesign the Space Station. The Russians contribute every day to making the Space Station a much better facility. If we--when we redesigned the Space Station, we would not have permanent presence until September of 2003. We now feel that we are very close to having permanent presence 3 years early. That will allow us to do an enormous amount of research. We bought 4,000 hours of research, astronaut time from the Russians----

Mr. Frelinghuysen. We are buying astronaut time. What about all of these employees. What are they doing?

Mr. Goldin. They are working on equipment.

Mr. Frelinghuysen. To what degree are the tens of thousands of people that have been working with their space program, one would assume that their work with us is going to advance science and knowledge, but they obviously have defense satellites and other space work that has to do with their national security. To what extent do we monitor that activity?

Mr. Goldin. We are a civil space agency. We only work with the civil space program. I refer you to the people in the foreign policy establishment in the United States that will work with the Russians on other activities.

Mr. Frelinghuysen. But my point is, and this is my last point, we are in partnership with the Russians at the very time when some part of their apparatus continues in a way that might be considered to be somewhat adversarial in terms of their

national defense, the building up of their national defense. We seem to come to their aid relative to space exploration and the Mir, but in reality they continue to build up their defense capabilities that come through their space program in terms of bigger and better satellites and defense, quite honestly espionage, I would assume.

Mr. Goldin. I don't think that it is appropriate that the NASA Administrator comment on the thrust of what you are saying. But in civil space, the Russians are employing tens of thousands of people that could be working on other things in civil space. These people have done a superb job when funded by their government.

We have a significant benefit of having a backup system with the Proton, the Soyuz and the Progress in case our own Shuttle has a problem. If we did not have the Shuttle-Mir series of flights, we would not have the safest Space Station as we have today. There is a lot of research that is going on in zero gravity that the Russians have worked on that has helped us do better experiments in zero gravity. There has been a very significant technical benefit that we have accrued by working with the Russians. It is not as though we are doing the Russians a favor.

And on the duration of this program we have not given the Russians any grants. Everything they have done for us has been in the interest of the United States activity on the International Space Station.

Mr. Frelinghuysen. If the Russians do not deorbit the Mir in August, should we take that as a sign that they are not serious about the Space Station?

Mr. Goldin. If the Russians are able to obtain outside commercial financing to make a commercial venture out of the Mir Space Station, and under that condition they keep it up in the sky without impacting the deliveries to the International Space Station, I think that that would bode very well for the commercialization of the International Space Station.

But if the Russians keep the Mir up in the sky and use government resources that should go to the International Space Station, I think it would cause a very severe problem in our relations in civil space.

Mr. Frelinghuysen. It would destabilize our partnership in a very major way?

Mr. Goldin. I would say that would be a very negative activity if they were to do that.

Mr. Frelinghuysen. Thank you. Thank you, Mr. Chairman.

Mr. Walsh. Thank you, Mr. Frelinghuysen. Mr. Cramer.

SPACE LINER 100 PROGRAM

Mr. Cramer. Welcome, Mr. Goldin, to the committee. I want to talk to you about space transportation issues. I am an avid supporter of space transportation issues and of course you recognize that we have got to lower the cost of access to space. There are currently projects that you are carrying on, NASA is carrying on with the private industry on launch systems that will reduce launch costs by a factor of 10; is that correct?

Mr. Goldin. Yes.

Mr. Cramer. Talk to me about the Space Liner 100 program that examine ways to reduce launch costs by a factor of 100.

Mr. Goldin. The cost to access to space has been about $10,000 a pound and the reliability has been measured in parts per hundred for potential failure. This is not adequate. The Americans are still flying the Atlas, the Delta and the Titan, which were developed over 50 years ago by a number of great Americans, but we should not be flying these vehicles. The Shuttle was developed almost 30 years ago and we are still flying it. The Shuttle computational capacity is not as great as that of a laptop computer. We now carry 20 laptops on the Shuttle. Something radical has to change in America.

We used to launch 80 percent of the world's commercial spacecraft and we now launch 30 to 40 percent and you only have to pick up the newspaper to see what is going on in the rest of the world relative to launch. NASA is committed to revolutionizing launch, not making small evolutionary changes. Our first step was the X-33 and X-34 program, which would improve reliability by a factor of 10 and reduce costs by a factor of 10, and we think that we are on track within a decade to make that happen. But if we are going to be able to defend the Nation, if we are going to be able to really open the space frontier and have the laws of economic elasticity apply and achieve the goals that NASA has, we must get to a factor of 100 reduction in cost and a factor of 10,000 improvement in reliability.

This requires radical new information technologies. This will require radical new rocket technologies, materials technologies, and it is essential that we get on a path to make this happen. We have been exploring the concept called Space Liner 100 with just those goals and the folks down at NASA Marshall have come up with a concept where we use air out of the atmosphere rather than carrying oxidizers, which represents up to 70 percent of the weight of the vehicle.

We are looking at advanced technologies in materials and the way we initially launch it. Presently we launch vertically. We are looking at magnetic levitation launches, things out of science fiction, that could get the vehicle up to 600 miles per hour launching horizontally. We think these technologies are essential. Unfortunately, the present budget does not allow adequate resources to do those things.

Mr. Cramer. Why do we need a program like the Space Liner 100?

Mr. Goldin. If we intend to lead the world in the 21st century, space is a very crucial element. If people want to develop access in space, they cannot afford to pay $10,000 a pound to take payload up nor can they afford $1,000 a pound. We have to get closer to $100 a pound.

NASA is developing the technologies that will be available to the Department of Defense should they desire to perform missions up in space. This Space Liner 100 would give them the technologies that they need a generation from now to cause that to happen.

Mr. Cramer. Is it a demonstration program?

Mr. Goldin. Yes.

Mr. Cramer. In partnership with private industry?

Mr. Goldin. Clearly in partnership.

ADVANCED PROPULSION PHYSICS

Mr. Cramer. If we are going to do what you want to do, we have got to have a revolution in our understanding of advanced propulsion physics. Are we committing ourselves with funding and programs to advance ourselves in that category?

Mr. Goldin. We are doing the best we can, but I have to point out that our budget has come down every year for 6 years. I don't know of very many other agencies that have that, yet we continue to push the technological barriers. But at the present time we do not have the resources for a very robust program in the advanced technologies you have mentioned. It is a very lean program.

LIFE AND MICROGRAVITY SCIENCE MISSIONS

Mr. Cramer. I want to talk to you about life and microgravity science missions. Why are those missions being omitted from the Shuttle manifest?

Mr. Goldin. We are not omitting them from the Shuttle manifest; but once again the issue that we have is that we are building a Space Station. The NASA budget is not going up. We have to reprogram resources within our own budget to fund the things we have to do. I would love to spend more money in this area, and in fact we would love to have a number of dedicated additional missions on the Shuttle in this area, but at the present time we don't have all of the resources.

Right now over the next 4 years we will perform about 60 percent of the life and microgravity research that we have performed on the Mir and on the Shuttle between 1995 and 1998. We are putting additional lockers into the Shuttle and in the next year or two we will get up to 5 additional lockers where we can do additional research. We are developing express racks to put on the International Space Station. With the additional crew time that we have purchased from the Russians, we will be able to have a good program. But we are building the Space Station and there will be a period that we will not be able to do all of the research that we would like to do.

But I would like to help you understand the dilemma we have at NASA. I am very troubled by not being able to do this, but once again I want to show you this chart because I didn't show it to you before.

This is the NASA budget for the last 6 years. We aren't corrected for inflation. In real terms our budget has come down. We are doing what any good business does. You take your highest priority and you fund them and you cut your lowest priority. This is what the American people have asked of us. If the budget is to be balanced, you have to make hard decisions and if you try and fund everything inadequately, you do an inadequate job.

MICROGRAVITY SCIENCE RESEARCH

Mr. Cramer. Coming along this line, though, you have microgravity science research under two budget lines. The first is the life and microgravity sciences and applications and the

science aeronautics and technology appropriation, and then you have part of it under the International Space Station side. Because of budget overruns, schedule slips, decreased Russian participation, has that as much jeopardized what we have not been able to do on the microgravity science side?

Mr. Goldin. First, let me say that we are funding all of the investigators that we committed to fund for ground-based research, and we are ramping up to 900 investigators. We committed to that a number of years ago. We are funding all the key facilities, the core facilities for the Space Station.

The place that we have cut back a little bit, and I emphasize a little bit, measured in tens of percentage points, is in the unique research that is going to be done on orbit.

If you will, the analogy I have is we are building a house and it is very difficult to make all your meals in the kitchen while you are building the house. It is verydifficult.

Now, if we could have additional money, it would be about $110 million, we could fly some additional dedicated shuttle missions that would allow us to fill in the gap of the missing research that we are having in the life and microgravity sciences, and it is not for lack of wanting to do it, it is just the issue of being able to prioritize, given the fact that our budget keeps coming down.

Mr. Cramer. Well, are we more protected now, though? Because you said, I think I heard that the overruns are over with, or we think they are for a while, and that the Russian participation is a date certain for ending. So will that make the microgravity and life sciences commitment under the Space Station budget more reliable?

Mr. Goldin. I certainly hope so. I certainly hope so. But it is a very difficult grind to be able to continuously adapt with a declining budget.

RUSSIAN SPACE AGENCIES

Mr. Cramer. All right. If I could, one additional question about Russian space agencies. Eight of us went over there recently to address the Russian Duma over ballistic missile defense, but we met with the Khrunichev folks. Now, there are a number of opportunities, from the private sector with the Russian engines, but the space agency issues are divided between two agencies in Russia, are they not?

Mr. Goldin. I am sorry, I----

Mr. Cramer. From the Russian government's point of view, who controls the engines, the space engines that we have relied on?

Mr. Goldin. The Russian aerospace industry is a little different than ours. In America, we have NASA, which is wholly controlled by the Federal Government, and we at NASA work with independent corporations that have no relationship to the government.

In Russia, the Russian Space Agency owns a percentage of some of the corporations that do work for them, and it is a much more complex relationship. They have not completed the full activity towards privatization and separation of corporations and the government.

Given that role, the Russian Space Agency for civil space

activities is responsible for the engine work. However, Khrunichev has a number of contracts, commercial contracts where they sell launch services to other countries and companies around the world. The lion's share of those launch activities go through a partnership they have with the Lockheed Martin Company. How the Russian Space Agency relates to that activity I do not know.

Mr. Cramer. All right. Thank you, Mr. Chairman. That's all I have.

Mr. Walsh. Thanks, Bud. Mr. Sununu.

SMALL PLANETARY MISSIONS

Mr. Sununu. Thank you, Mr. Chairman.

Welcome, Mr. Goldin. Let me begin by just emphasizing how much I appreciate the difficulty of your task, and your relative success over the past several years, particularly making the transition from some of the most costly human space flight elements of the program and toward the smaller programs, leaner packages, as you have described them in your opening, and you have a very interesting graph in your presentation that shows the 11 small planetaries, many of which have received well justified accolades in their success, and more particularly in the level of their success relative to their cost.

So again, I think you have done a good job with the resources you have had, and I certainly applaud the transition in the mission, but obviously that doesn't change the fact that as Members of Congress responsible for appropriations, we are going to be concerned with the types of issues that have been spoken of previously, the Space Station and cost to Russia, and what is going to happen with Mir, and whether or not we are spending the $13.6 billion as effectively as we can.

Let me begin by asking about those small planetary missions. I am certainly not familiar with them all; I am familiar with a few. But rather than talk about history, let's talk about the future. What is the mission of the Genesis, which is scheduled to launch in early 2001?

Mr. Goldin. Genesis will go out and bring back samples of the solar wind and particles that come off the sun that people in the solar terrestrial physics field would like to get a better understanding of, and it will help us understand how our own sun operates.

Mr. Sununu. You say go out and bring back, but it is not going to return to Earth?

Mr. Goldin. Yes, it is. It is going to bring back----

Mr. Sununu. What is its orbitary path, then? How far out does it go?

Mr. Goldin. I believe it will stay at about one astronomical unit, but it will leave Earth orbit, collect the material----

Mr. Sununu. So it will be able to measure the solar winds in close proximity to Earth and it will go one astronomical----

Mr. Goldin. It is about 93 million miles away from the sun.

Mr. Sununu. Okay. And then return. So it will be the solar winds in that entire transition space.

Mr. Goldin. It will collect samples from the solar wind and

then land it back on Earth where we can analyze it in the laboratory.

TRIANA

Mr. Sununu. Measuring the solar winds, that is one of the 3 scientific packages on the Triana as well, is that correct?

Mr. Goldin. Yes.

Mr. Sununu. And that in that sense it will be, although this doesn't launch until 2001, it will be redundant to one of the three packages on the Triana?

Mr. Goldin. Triana is a package that will be looking towards the sun, and this package will be, if you will, a weather station of the solar flux coming to Earth. This is a very important measurement, because understanding that will help us give early warning to communications spacecraft. It will be important to give early warning to people that operate power plants. But it will be a monitor, not a sample measurement. It is two different measurements. They are complementary, if you will.

Mr. Sununu. There will be no other satellite in the L-1 position measures solar wind?

Mr. Goldin. At the present time, there is a spacecraft there called ACE. That is a measurement of the solar wind. ACE was launched a few years ago, and its operational life will be over and Triana will be an additional set of measurements for that.

Mr. Sununu. So there is a craft there that is measuring solar wind?

Mr. Goldin. Right.

Mr. Sununu. That is obviously somewhat problematic tothose of us that are looking at the cost-benefit of these various projects, that there is redundancy in that particular area of Triana's mission. But before getting into detail on the other components of the mission, let's talk about the cost, just so that I am clear on the cost. As I understand it, the estimate right now is $75 million, is that correct?

Mr. Goldin. Yes, that is correct.

Mr. Sununu. Over the past year, the estimate of cost has increased by 50 percent, from $50 million to $75 million. And I think it is a very legitimate question. What assurance do we have that it is not going to increase by another $25 million by the time we next get together here?

Mr. Goldin. With regards to Triana, our assessment for the initial system was $50 million. When we went out for inputs from the scientific community, they had recommended some additional instruments and it is those additional instruments that we put onto the spacecraft that led to the $25 million of added cost. But from a science-to-cost-benefit ratio, we thought it was the right thing to do.

Mr. Sununu. Does that $75 million include the cost of launch?

Mr. Goldin. Yes. It is a secondary payload on the Shuttle.

Mr. Sununu. My sense is that the reason some of these other packages were added on, and the reason the cost was increased another $25 million is because there was I think very limited, if any, scientific utility to the original scope of the project. Do you agree?

Mr. Goldin. The basic measurement that Triana was going to make was measurement of the heat balance on the sunlit portion of the Earth, which is a very important measurement. That is a good measurement, it remains a good measurement, but when we went out for scientific peer review, there were a number of very specific suggestions made that would enhance the value of the mission.

Mr. Sununu. Well, with all due respect, that wasn't the description of the project that was originally presented by the agency. The original description of the project was visual, it was sunlit, a full disk view, a 5-year operational mission, one new image downlinked every few minutes. There is no suggestion here about a heat balance. You are talking about measuring the reflected radiation from the Earth, correct?

Mr. Goldin. Yes, we are.

Mr. Sununu. I believe that package was also added as part of the submission to the private sector for comment?

Mr. Goldin. I think that that measurement came from the basic camera that we had on it. Let me just check, because I would like to be correct.

Mr. Sununu. I am reading from an agency press release.

Mr. Goldin. You were right, I was wrong.

Mr. Sununu. Thank you.

The original program was a camera, was visual, it is described as an Earth polychromatic imaging camera, which the best scientific people that I put on that phrase were able to tell me it is color video. It is 2000 pixels, so we are going to get a resolution of 5 to 10 kilometers on the image. And I think everyone in this room can appreciate the natural beauty of an Earth-borne image of the Earth, but it would seem to me that at least as regard to this video image, the scientific utility of that instrument package is zero.

Mr. Goldin. I don't know that it is zero. Let me----

Mr. Sununu. What is the scientific utility of a 5 to 10 kilometer resolution image of the Earth?

Mr. Goldin. For a number of years now, we have had satellites at geostationary orbit. In order to piece together a full image of the sunlit Earth would take hours. One of the things that we at NASA are trying to experiment with is to see if we would like to have a satellite at the L-1 and L-2 points that would be able to peer down at Earth. Now, when they first put those spacecraft up in geostationary orbit, they did not go to the L-1 point because mirror technology would not allow them to get an equivalent resolution. We wanted to have a spacecraft that would operate at the L-1 point to give us some experience there, because we believe with mirror technologies that are developing, that we, NASA are developing, it raised the possibility of looking at the full sunlit disk, if you put a satellite at the L-2 point at the dark side of the Earth and you could have complete measurements of the Earth.

Mr. Sununu. That is a description of the utility of having satellites at the L-1 point conducting a variety of different scientific experiments. That is not a justification of the scientific utility of a video image of the Earth taken from the L-1 point.

Mr. Goldin. We are an R&D agency. We try and do the right thing. We went through an open scientific peer review process

saying we would like to learn how to operate at the L-1 point. NASA came up with an initial concept----

Mr. Sununu. But to be clear, you already operate at the L-1 point. You operate the ACE at the L-1 point as you just described and you also operate the SOHO at the L-1 point.

Mr. Goldin. But those are solar pointing only. We had never operated a spacecraft at the L-1 point that looked back at Earth, and there is a significant problem in trying to stitch together data to watch storms move across the face of the Earth.

Mr. Sununu. But to the extent that we are undertaking an effort to give you experience for operating at the L-1 point, which I wouldn't disagree that an operation at the L-1 point in and of itself has scientific utility, but the question is obviously at what cost do we develop experience. We want to have some sort of a mission that obviously contains image packages that have scientific utility. I would like to at least finish this line of questioning.

Do your best. If you would like to go out into the scientific community and have someone provide a description for me as to the scientific utility of the video image of the Earth, 2000 pixel resolution, what is the value of that? I have yet to see any justification of the scientific utility of that image.

[The information on Triana follows:]

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

Mr. Goldin. Again----

REFLECTED RADIATION IMAGE

Mr. Sununu. Well, we can come back to this in the second round.

You talked about the solar wind measurement. Obviously there is some redundancy of that mission with ACE. Finally, there is the reflected radiation of the Earth's disk. That is the third package, the one you spoke of first in trying to justify the scientific utility of the project.

It wasn't part of the original package, and I recognize that there is no--nothing in L-1 right now that can give us the entire image at once, but the reflected radiation measurements can be put together by various lower orbiting satellites, can they not, in order to put together asummation of what the total reflectivity of the Earth is?

Mr. Goldin. This is not my area of expertise, however--and we will get for the record the details of this. But to stitch together those measurements from different satellites has not given us the accuracy we believe we could get by looking at the whole Earth. There is a real lack of accuracy in being able to understand the reflected light from the Earth's atmosphere and what gets absorbed. This is a very important measurement, and we believe that this is the right way to get at that measurement.

I want to come back and say that when we started this

program, we only had a starting point. Right now, we believe we have a very scientifically sound approach. It is not uncommon to have programs like this. We go to the scientific community to get validation, and I believe we are on the right path and this program will give us the good science that we need to do our job.

[The information follows:]

Triana's Measurement of Reflected Radiation

Triana's measurements of reflected radiation are complimentary to those taken from low and geostationary Earth orbits. Its position at L1, with the Sun directly behind it, allows a view of radiance angles that is advantageous in detecting differences in reflectance between cloudy and clear-sky at the level of the total Earth disk (i.e., treating the Earth as a point source and getting a single albedo number). This measurement can be taken at other locations of comparable distances to L1. However, because L1 is the neutral gravity point between the Earth and Sun, it is a stable point of observation. Also, because it is in the Earth-Sun line of sight, it will get the retro-reflectance, or ``hotspot'' views that is not available from other locations.

Mr. Sununu. Well----

Mr. Walsh. Excuse me. All right. Proceed, but I would like to ask you to wrap up. We are going to be back again later for another round and this afternoon also.

Mr. Sununu. The genesis, no pun intended, of this program is a bit unique. I think there is no, there is no question in my mind that the scientific utility of the project as was originally scoped out, not by NASA, but by others, was not just limited, but nearly zero, and certainly not worth the original $50 million price tag. I respect the fact that in doing what you need to do to provide any justification for spending $75 million, you have been able to add a couple of small packages on the system that would increase its scientific utility. One of those systems is quite redundant. One of those systems, the radiometer, can be supplanted I think through other methodologies. You mentioned the accuracy. I appreciate, in the interests of science, improving our measurement accuracies. If you could provide me with a summary of what the improvement in accuracy of this observatory station compared to other low-orbiting satellite measurements on the reflected radiation would be, I would appreciate that very much.

You talk about priorities, and I have great respect for your ability to set priorities intelligently, and again I recognize how difficult your mission is. But I think that the priority of this project isn't just low in the pack, I think it is at the bottom of the pack, and I think unless the agency or others can provide a stronger justification for it, I think it is going to be very difficult to approve funding for this kind of a package, especially given the other needs in the agency that Mr. Cramer and others and the chairman have spoken about, and you have spoken about. I will have to leave it at that. You will have ample time to comment later, and as you know, I very much appreciate your personal comments on this and other

topics. Thank you.

Mr. Goldin. I will be pleased to respond in detail.

[The information follows:]

Triana's Measurement of Reflected Radiation

The value of Triana's measurement of reflected radiation is not in improving accuracy per se, but in its addition of the full disk view, providing an additional data set from another viewing angle. Researchers studying the Earth's radiative energy balance have competing models that differ by about 8% in estimating radiation absorbed by the atmosphere. This 8% is the largest uncertainty among the climate-relevant impacts of solar radiation. Triana will provide part of the answer by enabling calculation of the infrared to total radiative energy ratio for its particular observing angle, which has never been done with a full disk view. The additional data set provided by Triana should help bring these competing camps closer together, by providing evidence of which of the two competing models has the better set of starting assumptions..

Mr. Walsh. Thank you. That was a very good, thorough line of questions. I think we may want to revisit some of that later on.

Mrs. Meek.

NASA's budgetary decline

Mrs. Meek. Thank you, Mr. Chairman.

Welcome, Mr. Goldin. I certainly appreciate the efficacy in which you and your staff have led NASA. Mr. Goldin and I, a colleague of mine from Florida, we have been very concerned about NASA's budgetary decline over the years, and we have been strong proponents of trying to be sure that NASA is adequately funded. This has not been a winning kind of position we have taken. He is from Florida and I am from Florida, and we have seen NASA grow and we have seen it now, with its budget declining, having to set priorities which, in many instances, sort of not decimate, but cut very strongly on programs which we know are essential. But with your being the person who manages that program, there are certain decisions which you have to make, and this committee certainly will appreciate you making those decisions in the light of the amount of funding that you get.

He is not here today; I am sure he is going to come in before you leave, Mr. Goldin. He is from Pensacola, from west Florida, and we have watched the space program for a very long time, and I have been able to visit Kennedy and to see what you are doing there, and to see how important it is to be able to fund these scientific programs.

BUSINESS INCUBATORS AND TECHNOLOGY-TYPE PROGRAMS

My questions are some that I will constantly ask you, and each time I ask these questions I do get very responsive answers. One has to do with your business incubator and your technology-type programs, the transfer that you have there. You

are not only doing kinds of programs that are purely scientific, but you are trying to transfer these programs so that we can build better businesses and certainly help the economy as well.

Your motivation for business and economical growth is a good one, as I see it, and I wish that this committee would note that.

Many of our communities throughout the country are searching for jobs and economic development. Would you comment on the priority that this kind of technology transfer is to NASA and in your small business development arena?

Mr. Goldin. NASA has been very successful in its business incubators in transferring technology to the commercial sector. It is very important that as we develop these advanced technologies that allow us to send spacecraft to other planets in our solar system, to operate the Shuttle, to build a Space Station, to monitor the characteristics of our own Earth that we pass them into the commercial sector. We have found that the existing incubators were quite successful, and as a result of last year, there was an earmark placed to increase the number of incubators. We will now have an incubator associated with each of our NASA centers, and in fact in Florida there will be 5 or 6 other incubators associated with the TDMA organization. Is that the right?----

Mrs. Meek. TRDA.

Mr. Goldin. TRDA, I am sorry, in Florida.

We think this is a very, very good program, and has had a very good track record. We watch over it and we are going to continue to work in this area.

DOWNSIZING AT NASA

Mrs. Meek. I was visited, Mr. Goldin, last year. You were downsizing in NASA last year. That is evident now in your budget. Some of the workers from Kennedy visited me, and they were concerned about the downsizing. And of course I talked to you and some Members of your staff about this.

How is that working? What did you do relative to the stations like Kennedy and some of the rest?

Mr. Goldin. Well----

Mrs. Meek. What I am really getting after, did you really downsize to the point you had to fire people?

Mr. Goldin. No. I am very proud at NASA. We have downsized from about 25,000 employees down to, I think we are at 18,600 right now, without one forced departure from NASA. I think this is a very strong statement about how we work at NASA. With the help of the Congress, we have been able to have buyouts, and in fact, we intend to downsize, we are going to continue going with voluntary separations of about another 1,000 people. That is a huge reduction in force.

However, we put safety as our number one priority, and it turns out that at Kennedy, Johnson and Marshall we were coming down with voluntary retirements too fast and we wanted to maintain the strength of the labor force, so in this year's budget we put in additional money so we would come down at a slower rate and be able to keep operations safe. We have tried to be very sensitive to treating employees as valued members of

the team, and we are doing everything possible and have been successful so far in downsizing as a percentage among the largest in the government without one forced layoff, and we intend to continue that because the morale of our team is very important and these people made NASA great and we are going to treat them with the dignity that they deserve.

SHUTTLE OPERATIONS

Mrs. Meek. In your budget request, you asked for $2.5 billion, a little more, for shuttle operations for an 8-month period. Has that changed any, your forecast for that, and do you still envision 8 shuttle launches in the year 2000? Have you outlined these missions for us in your presentation?

Mr. Goldin. I believe it is 8 missions in the fiscal year 2000, and if you will wait a moment, I could outline those missions for you.

I have STS numbers. If it is okay with you, for the record, what I would like to do is get you the title of those flights for fiscal year 2000, and our budget remains as is.

[The information follows:]

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

LAUNCHING OF NEW MISSIONS

Mrs. Meek. So, my last question, how much money are you committing in your budget for the launching of these new missions, vehicles that you use for launching? Did you estimate in your budget your commitment to developing these new launches?

Mr. Goldin. The budget for the Shuttle contains all of the resources necessary for the 8 launches that we have indicated in the manifest. It has all of the money necessary for those launches.

SCIENCE, ENGINEERING, MATHEMATICS AEROSPACE ACADEMY

Mrs. Meek. Well, in terms of the launches, I am very much interested in the vehicles that you use to do that. After visiting Kennedy, I could see the enormity of that particular kind of thing, and that is why I asked that question.

My last question has to do with the SEMAA program, which has been a very, very productive and responsive kind of program. Can you tell us something about it in terms of how it is working and just a little statement regarding SEMAA? That is the Science, Engineering and Math programs. That means a lot in our school systems as well as in most of our communities.

Mr. Goldin. This is a program that was started at the NASA Lewis Research Center and their concern about youngsters not doing well in math and science, especially youngsters in the minority community that just haven't been doing well intesting. It is a very creative program that has been very, very successful. It was so successful that we used that model in Cleveland to start up programs in other areas in Ohio, and then ultimately we hope to expand

this around the country. Given the pressures on our budget, this is one of the other areas that we haven't been able to fund at adequate levels. I feel terrible about that, but we had to make some calculated decisions that we will not be able to expand the SEMAA program to the level that we would like to.

Mrs. Meek. Mr. Chairman, I will ask the rest of my questions later.

Mr. Walsh. If you are finished, we will have another session this afternoon, and there may be another opportunity this morning, depending on how time goes. Thank you.

Mr. Goldin. Excuse me. Mr. Chairman, could I just add one thing to the question Mrs. Meek asked. For the record I will put in all of the sites we have, the existing sites and the new SEMAA sites and the actual funding levels we have. But the concern I have is here is an opportunity to really have an impact, but given the stresses on the budget, we are not able to expand the SEMAA program to the level we desire.

[The information follows:]

Science, Engineering, Mathematics Aerospace Academy (SEMAA) Replication

The success of the SEMAA program at Cuyahoga Community College in Cleveland has led to its nation-wide replication:

Detroit, MI--Wayne County Community College
Dayton, OH--Sinclair Community College
Washington DC--DC Public Schools and the University of the District of Columbia
Atlanta, GA--Fernbank Science Center
Chicago, IL--Chicago Public Schools
Jamaica, NY--York College
Additional sites to be added in Baltimore, MD; Greenville, NC; St. Louis, MO.

During the past budget year NASA was given $10M for the replication of 7 new sites and the continuation of the existing sites.

Mrs. Meek. Thank you.

Mr. Walsh. Thank you. Mrs. Northup.

NEW AGREEMENTS--SPACE STATION COOPERATION

Mrs. Northup. Thank you.

Welcome, Mr. Goldin. I am quite in awe of what is accomplished in the space program and I struggle to keep up with an understanding of it, but I am eager to see your work progress and progress efficiently and quickly, and I believe it is essential to our country's purpose.

I do want to ask you, though, several questions, and I will start right out with asking you whether there will be any joint announcements about Space Station cooperation, new agreements, working together with Mr. Primakov's visit next week.

Mr. Goldin. I don't know. Mr. Primakov is scheduled to meet with Mr. Gore I believe from tonight through Thursday, and I will be attending those meetings on Wednesday, and I will hope that what will come out of those meetings is a rededication of the Russian government to pay their bills to the Russian Space

Agency so we can continue this program. I don't anticipate any major new agreements coming out of that relative to the Space Station. We are very close to getting that service module up on orbit, and if we could get the appropriate funding from the Russian government to the Russian Space Agency, we will be there.

COOPERATION WITH RUSSIA

Mrs. Northup. I want to return to funding. I think the cooperation with Russia and our relationship with Russia, I am concerned in a number of areas. First of all, I am interested in sort of what the autonomy is between your--between NASA and the Russian space organization in terms of, let me say of other departments in this country, other cabinets that have an interest in our relationship with Russia.

Mr. Goldin. I feel that we have complete freedom within the laws of the land, within appropriate laws, or appropriate agreements that the Russians are supposed to operate within to do the things that we need to do. Clearly, there are issues of foreign policy that when they come up we refer them to other agencies of government, but given the actual building of the Space Station, the relationship we have with the Russian Space Agency, I believe we have appropriate freedom to do what is right.

Mrs. Northup. Well, you know, sort of going in either direction too far would be a concern, but let me start right out by saying if you believe tomorrow that cost-wise it made no sense for us to continue with Russia as a partner, could you decide to end that?

Mr. Goldin. We have a set of agreements with Russia, and clearly, these agreements are agreements at a government-to-government level. But certainly, if I felt that there was something improper, I would make the appropriate recommendations.

Mrs. Northup. Well, I am not necessarily talking about improper. I mean the fact is they haven't lived up to their agreements in terms of being able to pay and deliver. I mean originally we expected that we would save $2 billion by your own testimony, I believe, by cooperating with the Russians. Now we know it is actually going to cost us. There will be no savings. It is actually going to cost us $1 billion more to cooperate with the Russians. So based on that, based on the concerns you are hearing from this committee, if you decided that the best way to get that up and get it operating would be to say to the Russians, I am sorry, we can't afford your participation, and end it, could you do that?

Mr. Goldin. Well, before I answer the hypothetical question, I would like to correct something--I would like to just provide some background on where we are. If we were to separate from the Russians right now and not take delivery of the service module on orbit, which we want and which we need, it could delay the program by years and cost yet billions of dollars additional. I don't see the upside of separating at the present time from the Russians. I don't know how to put a value on the Russians having the backup Proton, Soyuz and Progress vehicles, which we think is essential and which was the

foundation of why we entered in with them.

DEVELOPMENT OF PROPULSION MODULE

Mrs. Northup. But in fact, in your budget, don't you now have a new project to replace our dependence on them? Aren't we actually going to appropriate $780 million to actually replace any dependence on those products?

Mr. Goldin. We will be developing a propulsion modulewhich will allow us to operate in case the Russians don't launch Progress vehicles, but the fact that they have the Proton rocket and the Soyuz vehicle is very essential to us in case a problem happens with the Shuttle. If you will, it is a very, very important insurance policy.

Crew Return Vehicle

Mrs. Northup. Well, does that mean that your crew return vehicle that you are asking for appropriations for isn't actually going to go forward unless the Soyuz becomes not an option for us, or are we going to go on and develop that?

Mr. Goldin. We are going to develop the crew return vehicle, but it will not be available I believe until 2003, which is 4 years from now. So if we were to just say to the Russians we are not interested in working with you, we wouldn't have access to the Soyuz vehicle for that period of time. It just takes time to bring these things up and have them ready. So I don't think at the present time it would be in our interests to say, let's walk away. We are very close to getting that service module on orbit.

Intergovernmental Agreements

Mrs. Northup. Let me return to my original question. Is that strictly NASA's decision, or is that part of our foreign policy?

Mr. Goldin. NASA has agreements with the Russians, but some of these agreements are coordinated at higher levels of government, and certainly we would coordinate with the other levels of government before we would take such a decision.

Mrs. Northup. Let me get more--I guess I am having a hard time sort of understanding the answer here, so let me ask specific questions.

Do you hear from, for example, Secretary Albright about what she wants to have happen? Do you hear from other departments regularly about our continued relationship with Russia based on these projects?

When you decide that we are going to have to actually spend more, when there is in here additional appropriations for us to reimburse Russia for services that we didn't anticipate earlier, or to actually pay for receiving things, do you consult with the people that formulate our foreign policy?

Mr. Goldin. Well, 15 nations signed up to an intergovernmental agreement. It was not signed at my level, it was signed I believe at the Secretary of State level. These governments are committed to building the International Space Station. So it is not for NASA to take unilateral action.

Mrs. Northup. But did that include the price and the sort

of technology that would be transferred vis-a-vis the money that would be transferred?

Mr. Goldin. I don't believe costs were part of that, but I might point out that we have had issues with our other partners, it is just that we have had problems with the Russians. This is a U.S.-led space station and it is a very complicated set of issues.

Mrs. Northup. Well, Mr. Goldin, though, if I could say, throughout all of this I mean Russia is sort of the repeated issue in cost overruns. I mean there may be--I mean it dominates the testimony and the budget justifications. There may be issues, there are always issues.

Mr. Goldin. That is correct. The single biggest set of issues and problems we have are with the Russian government's inability to pay the Russian Space Agency to do the things that it promised in the intergovernmental agreement. That is a statement of fact.

Mrs. Northup. So let me now sort of turn away from just the financial issues and who is the controlling authority in this country about how long and how fragile or cemented this relationship is with Russia. I would say, though, let me just finish by saying that it seems to me there are a considerable number of expenses that are being proposed this time that are sort of based on the ``if Russia doesn't continue'' theory, as though we are at least entertaining within our government the idea that Russia wouldn't continue to be a partner forever.

Mr. Goldin. I don't believe that that is the basis for those investments we are making. We want to do the prudent and the right thing, and given the economic condition in Russia, we are concerned that over the long run, there may be times when the Russians may not have enough money to do the things they said they would do, and given the level of investment we are making, we think it is the prudent thing to have this equipment on orbit. If the Russians do have the ability to meet their obligations, we still would like to have this equipment on orbit, because it gives us an additional level of insurance and redundancy. We do think that this is the right thing and making these investments is clearly a recommendation that NASA has made. We were not asked by any other level of government to do it, but the President and the OMB supported us when we made the recommendations to buy these insurance policies. But it does not presuppose that we think Russia is going to leave. It is there as an insurance policy.

Russia's Defense Industry

Mrs. Northup. Let me turn now to Russia's relationships in its own country with other scientific powers; specifically, its defense industry. I feel like these agreements were signed when there was an increasing reassurance in this country that the United States and Russia's best interests were on a parallel path. We hope they continue in that direction.

My question is, how much relationship in exchange of information, use of technological information is exchanged, do you believe, between the Russia space program and other scientists, particularly those involved in Russia's defense systems?

Mr. Goldin. We at NASA have a specific set of rules that we put in place on technology transfer to assure protection of U.S. technologies that are crucial to us not to go to Russia. I don't know how to comment on what discussions the Russian Space Agency has with their own defense establishment. I can only say that in the United States, we, NASA, are very supportive of our own defense establishment, and when they come to us and we have technologies that they could use, we do make those technologies available to them.

Mrs. Northup. But do you assume that happens in Russia too?

Mr. Goldin. I just don't know.

Mrs. Northup. What is your assumption? Is your assumption that it does? I mean you almost sound as like of course that is what happens every day.

Mr. Goldin. I always am hesitant to comment on something that I don't have specific knowledge on.

United States Defense Industry

Mrs. Northup. How often does technology that you have help our Department of Defense in their creation ormaintenance of our weapons systems?

Mr. Goldin. Well, I could say that NASA is playing a major role in the development of reusable launch systems that will be of great benefit to the defense of this Nation. NASA plays a very great role in aeronautics technologies. We do an enormous amount of testing for the Defense Department, and today, even though our aeronautics budget is low, we are assuming more and more of a responsibility for the long-range aero propulsion technologies that the Defense Department is going to rely on. So we don't develop weapons, I want to be clear about that, but we do act as a good partner to the defense of our Nation.

Mr. Hobson. If the gentlewoman will yield, I am going to ask some questions about that, because there are some positive things happening between Wright Patterson Air Force Base, NASA, and Glenn in Ohio.

Mrs. Northup. With all due respect, my concern is entirely different, and that is that as we pour billions of dollars into Russian space programs that we, in a sense, are indirectly aiding their defense programs, and that if their defense--if they are a very unstable country, is anybody, is anybody at any level sort of judging whether indirectly we are fueling their defense industry?

Mr. Goldin. Let me make one thing clear. We have a very limited number of dollars going to Russia. Last year I think we purchased $60 million of goods and services, and this year we are going to anticipate buying $100 million. We are not buying billions of dollars from the Russians.

Mrs. Northup. Don't you have a projection for next year's budget?

Mr. Goldin. Zero.

Mrs. Northup. Zero, okay.

Mr. Goldin. It is zero thereon. So there is a perception that we are funding the Russian space program with billions of dollars. We are not. We are expecting the Russian government to fund the Russian Space Agency at the levels that they committed to so that the Russian Space Agency can meet their obligations

to us. Every time the Russian Space Agency has been funded at appropriate levels, they do really good work. So our issue is that the Russian government makes commitments in its appropriations process in its Duma, and the money does not flow to the Russian Space Agency, which causes our problems.

I also want to say that we certainly rely on the foreign policy establishment of the United States to protect critical assets of the United States and, clearly, we consult with them to assure that we are living within the laws of the land and doing the appropriate thing, and we do participate in those meetings.

Mr. Walsh. Mrs. Northup, could I just interrupt for just a second. We have been pretty liberal with the time, giving everybody a chance to really explore their questions, but we are up over 15 minutes now, so if you could----

Mrs. Northup. That is fine.

Mr. Walsh. Do you want to wrap up?

Mrs. Northup. Well, I would just say, you know, what you have said to me, that there is a lot of information developed by NASA that is of great interest and use to our Department of Defense. These are the same scientists that are working with Russia, and I am concerned about who is sort of the controlling authority in sharing that information, that technology, and/or, even if there is none that crosses international grounds, what sort of work goes on in Russia based on our encouraging of a space program and a partnership that then becomes of use to their Defense Department.

Mr. Goldin. We, NASA, abide by the rules of export control and technology transfer. There are very specific rules that we live under.

John Shumacher, who is the Associate Administrator for External Relations, carries out those rules. We check and we validate. So we live within our laws to not transfer technology to Russia.

The thing that I am just reluctant to comment on, Russia is a sovereign nation. If they have a space agency that does something equivalent to what we, NASA, do in our own country, I just don't know how to comment on that, except to say we are working with them in civil space. We believe we are doing the appropriate thing in our relationship, and we rely upon the foreign policy and intelligence establishment of this Nation to tell us whether we are on the right track.

Mrs. Northup. Thank you, Mr. Chairman.

Mr. Walsh. Mr. Price.

Increasing Cost of the International Space Station

Mr. Price. Thank you, Mr. Chairman.

Mr. Goldin, welcome back to the subcommittee. Glad to see you again.

You may notice, if you have checked the transcript from last year, that there is a certain repetitiveness in the questions that I am going to ask. That is not because I or my staff lack imagination, however, it is because we don't seem to have made a lot of progress on some of the matters that we did discuss, and so I hope your answers will be somewhat different this year. We do, I think, need to revisit some of these

matters, which mainly have to do with academic and research programs at NASA.

Many colleagues, myself included, have expressed concerns about the increasing costs of the International Space Station. I am a supporter of the station, but I am becoming increasingly aware that increased station costs and pressures on the NASA budget overall are cutting away at other NASA programs, academic, education and research programs in particular.

Cut in Academic Programs

The academic programs at NASA are slated for a $17.5 million decrease from $71.6 million to $54.1 million in your budget request with a large portion of this decrease coming in educational technology. In particular, the space grant college and fellowship program would be cut in the President's budget by nearly 30 percent, from $19 million to $13.5 million.

Now, last year I asked whether NASA supported the programs funded in the academic program, and if so, why was there such a dramatic cut proposed when you came here last year? Was it because of Space Station, or was there some other factor? The answer I received was actually that NASA had made a mistake in that request, in the space grant request, and that it would be fixed in the fiscal year 2000 operating plan. Yet, the requests we are dealing with this year, it looks to me like almost the identical request that supposedly was mistaken last year.

So what is going on? I do think we need an explanation. And if it was a mistake last year, why is the mistake being repeated in requesting this kind of draconian cut in these academic programs?

Mr. Goldin. First, let me ask Mr. Peterson, who is the NASA comptroller, to answer the question on the mistake oflast year, because he is the one who pointed it out to me and I will add the broader context to your question.

Mr. Peterson. Sir, last year we made a mistake in our final allocations of the Fiscal Year 1999 budget proposal to you, and indeed, of course it did get fixed in the 1999 operating plan. A significant amount of money was added by this committee and others in the Congress to our academic programs. When we came to the fiscal year 2000 budget, when we had to resolve the final numbers with the Office of Management and Budget, given the direction that we were under, we were not able to fund the academic programs at the level that we had intended to fund them in 2000. When we have come forward to brief the Congressional committee staff, we have acknowledged our extreme regret that that was the case and have asked for some latitude in the fiscal year 2000 operating plan to resolve that issue.

Mr. Goldin. I would like to add a broader context. It is not the International Space Station because we did not touch the education budget for that. But what I would like to point out is something that happens year after year, and I know the Members are very interested in the NASA space program, but when you take a sum of the administration actions and the congressional actions, I showed this before. This is a very important chart to note. The NASA budget has come down about $1 billion over the last 6 years. It came down about $100 million this year, and I know the tremendous interest people have.

When I read about the Federal budget, if you take a look at the broad range of the Federal budget, the goal is to keep the agencies on track with inflation. Not only do we not get correction for inflation, but our budget is coming down $1 billion, $100 million in the last year. This is something that is very, very difficult to do, but being committed to a balanced budget, I feel everyone ought to kick in.

Another misnomer is the Space Station is using up the research funds, and I have a curve here which shows the total human space flight program measured over time, and in 1999, it crossed over, and this bottom line is the Space Station plus the Space Shuttle, and this is our science budget. The science budget is going up each and every year while the sum of the Shuttle and the Space Station, costs go down.

Now, I know that that is not solace for this education budget, which I agree is very, very important. The dilemma that we have is given this situation with the NASA budget, and I don't know that there are very many other agencies of the Federal Government that have this situation, given this, we don't know what to do. Education I believe is very important, and what we did is we maintained the education funding at the level we had before the additional money was put in for the earmarks. We didn't know what else to do, and I am very, very frustrated. If given just a level budget, we would be able to deal with it. But each year the budget comes down, and I don't know where to go to do the right thing. It is a very, very high level of frustration to me, and your being concerned, I will agree with you again this year. I just don't know what to do.

GUIDELINE LEVELS FOR ACADEMIC PROGRAMS

Mr. Price. Well, as you said, the fix last year involved a substantial increment of funding added by this committee and by the Congress. Is that possibly what is going on here with the concentration of the cuts in these accounts? Are you cutting items you think Congress will increase? I mean what explains the disproportionate cut here? I am just struggling to understand. I understand the overall budgetary pressures. I understand you are eager not to have a trade-off with the Space Station perceived, although the chart that you referred to, while a long-term trend is as you describe it, the year 2000 trend is for a steeper increase in the Space Station account than in space science generally, and you anticipate apparently a reversal of that trend.

Mr. Peterson. Sir, if I may respond, the guidance that we operate under in formulating this budget was to adhere to the previous guideline levels. The previous guideline levels for the academic programs for fiscal year 2000 is exactly the amount we requested. We were allowed to go above guideline only for two areas. One was the Space Station and the other was for some technology investments. The Office of Management and Budget held all of the programs to their previous guideline levels. So it would have been an increase to that guideline--actually that we proposed and did not receive in the education programs area.

Mr. Price. How does that----

Mr. Peterson. We did not cut it, although relative to the

1999 President's requested level, it is certainly a cut in funding from the FR 99 enacted level. However, it is absolutely consistent with the budget plan that the administration put forward last year for fiscal year 1999.

Mr. Price. Well, that is true, because it was a cut last year, which was described in this hearing as actually a mistake, and Congress put the funding back in. So is that what you mean, that the request is consistent with last year's request?

Mr. Peterson. Yes. The fiscal year 2000 request is the same as our plan was in the fiscal year 1999 run-out. We were not allowed an increase. That is unlike the case in the fiscal year 1999 where a mistake was made by us in the final allocation of the agency, internal distributions. In this case, we did not have that luxury.

Mr. Price. These guidelines you are describing take no account of last year's congressional action.

Mr. Peterson. That is correct, sir.

Mr. Price. And basically revert to last year's administration request.

Mr. Peterson. That is correct, sir.

MOVING PROGRAMS FROM PHASE II TO PHASE I

Mr. Price. Was the fiscal year 1998 budget used in the same way that the fiscal year 1999 budget is projected to be used? Here is the reason I ask that question and what I am specifically interested in.

The potential for elevating some of these Phase II programs to Phase I, which of course does imply a higher funding level and a more advanced status for these projects. As I understand it, about $1 million of the congressional add-on went to what you call designated competition, which is designed to elevate some of these Phase II projects to Phase I status. If I am wrong in that assumption, please tell me. But that is my understanding, and that is almost $1 million in your current fiscal year 1999 budget breakdown. So that is one question. What kind of success have you had in moving the Phase II projects to Phase I, and then what if we made a similar addition this year for fiscal year 2000? Could we anticipate that--and that of course would just simply be flat funding from what you have this year. Could we anticipate that that would enable you to transfer, or transform Phase IIprograms into Phase I?

Mr. Peterson. Yes, sir. We are, in fact, doing so in fiscal year 1999, moving programs from Phase II to Phase I.

Mr. Price. What number of programs?

Mr. Peterson. The selections are for four new programs that are going to move up to that level.

Mr. Price. So that is in the designated competition item, that is the way that is being spent.

Mr. Peterson. Yes, sir. And we are unable to maintain the same funding level for all of the consortia in the fiscal year 2000 budget without increased funds. So what we would be doing is taking sort of an across-the-board reduction. Instead of eliminating designated, what we would be doing is giving everyone a little bit less money.

Mr. Price. So you would anticipate, even with your--even with the reduced fiscal year 2000 budget request, you would still be able to move four additional programs into Phase I?

Mr. Peterson. Sir, I think I better defer on that. I will give you an answer for the record. I don't know that given the funding level which is clearly inadequate, whether I know whether that moving 4 additional programs up is in the cards.

Mr. Price. Well, let me ask you to give us three kinds of information for the record. Number one, an account of the programs that are being moved up this year; number two, the programs that--the number of programs you would expect to be able to supplement, upgrade with your current budget request; and then thirdly, the number that could receive that treatment with an increase similar to what the Congress voted last year.

Mr. Peterson. Yes, sir.

[The information follows:]

Phase II to Phase I Programs

An account of the programs that are being moved up this year:

There are 21 consortia that are eligible for the upgrade to Phase I. We received 11 proposals of which 4 will be selected in August, 1999.

The number of programs that you would expect to supplement/ upgrade with your current budget request:

In FY 1999, we will have upgraded 4 consortia; with the current FY 2000 request, there are no plans to upgrade additional consortia.

The number that could receive the Phase I upgrade with an increase similar to what the Congress voted last year:

None. The FY 1999 funding of 19.1 M allowed for 4 upgrades. At that level in FY 2000, we would be able to maintain all of our consortia at their current (and newly upgraded levels). To upgrade additional states beyond the 4, we would need a SG budget greater than 19.1.

Just a reminder, the 19.1M in FY 1998 and FY 1999 allowed for a 25% increase in the base award for all consortia, in addition to the opportunity to upgrade 4 consortia to designated status.

HIGH-SPEED RESEARCH ACCOUNT

Mr. Price. All right.

Another area with a large decrease is the aeronautic research and technology account. Now, as I understand it, the majority of this decrease is due to the closing out of the high-speed research account.

Can you explain that closing out, and particularly, what kind of point we are at with respect to transferring this to the private sector and enabling private industry to produce a high speed civil transport?

Mr. Goldin. This was a very difficult termination, especially since I was involved in its initiation. The dilemma we had is we have one major airframe company in America, Boeing, and we had a contract with Boeing to develop the technology that could lead to a high-speed civil transport.

Boeing had been very supportive of this approach and really was committed to the future, with this very critical technology, which is probably about 20 years off, because it is a very long-lead, very highly intensive R&D activity. With the downturn in the Asian market, and the financial conditions that the Boeing Company had found itself in, it was a cooperative agreement, so it was a Space Act agreement, so they had to provide in-kind goods and services which was creating a significant financial problem for them.

So the Boeing Company made a corporate decision that they would not be able to work with us on this since this was so far out, and they had incredible pressures in the near term. So independent of any other action, we decided without a commercial partner that would actually be there to do the development and building and selling of these planes, it would be inappropriate for NASA to continue with this on our own.

It is a very, very significant decision because the High Speed Civil Transport (HSCT) program is delivering unbelievable technologies that we feel are breakthroughs. We had the goal of developing a plane that would carry 300 people 5,000 miles at knot 2.4. That would allow the plane to have such a high productivity, to go back and forth across the ocean twice in 1 day, and it looked like it really was going to have a huge impact on the future. But because we didn't have a partner, there was no fee involved in this contract that we had, but Boeing wasn't there to do it. So we are going to have to regroup and figure out what we should do now.

But we also ought to take a good hard look at this. This is a very loud signal that we are receiving about the ability of American corporations to look 20 years out in the future. I am very concerned about the signal we are receiving.

Another area of concern that I have, if you take a look at the jet engines that used to be sold in America just a generation ago, 75 percent were sold to the Department of Defense, and 25 percent were sold to commercial airliners. Today it is reversed. It is 75 percent commercial and 25 percent to Department of Defense.

And if we take a look at where this technology is going, if America does not lead the world in the commercial aeronautics sector, it will have a significant impact on our defense. So we at NASA are regrouping. We are very concerned about this signal, and just yesterday I met with the leadership of the airline industry, the airports and the manufacturers, and we are openly discussing the implication of what happened on this High Speed Civil Transport.

I am very concerned. I don't have the answers yet, but I do intend to talk to the highest levels of government and industry, and I would like to talk to this committee about the subject because there are other things that this government is not doing that are essential for the commercial vitality that no one corporation could afford to fund, and this is something that we really need to explore together.

Mr. Price. So the reduced request that we are referring to is a negative rather than a positive signal in terms of aprospect for a timely commercialization?

Mr. Goldin. Yes. I think we have lost about 10 years on this possibility.

Commercializaton Plan for the Space Station

Mr. Price. I know that my time has expired, Mr. Chairman. I would like to pursue, or maybe you can submit for the record some kind of--you have a commercialization plan for the Space Station dated November 16, 1998. I assume that helps explain some of the declining costs that you are projecting there. Maybe it doesn't, but I wonder what kind of lessons, positive and negative, this high-speed privatization experience may hold for your projected plans for the Space Station.

Mr. Walsh. Maybe you could provide that in a thoughtful written response.

Mr. Goldin. I would be honored to do that.

[The information follows:]

High Speed Civil Transport

The privatization experience associated with High Speed Civil Transports (HSCT) is very different from the commercialization of space, particularly the privatization of the Space Station. The United States airline industry has been privatized for years, employs millions of Americans, is the leader of the world-wide aviation industry and produces the largest balance of trade surplus in our country's exports. NASA's High Speed Research (HSR) program was focused on developing technology to enable HSCT to reduce travel time to the Far East and Europe by 50% within 25 years. The HSR program is being terminated at the end of FY99 because of change in support by industry partners brought about by emerging business trends. Nevertheless, the NASA program made significant progress toward the original targets developed at the beginning of the program. We are much closer today to a commercially viable supersonic transport, making major advancements in noise reduction, emissions reduction, weight reduction, and affordability. And while progress will slow significantly at this point, NASA will continue to support high-speed research through our basic research programs.

NASA's efforts on the Space Station are in an arena in which there is currently no industry. Whereas HSCT involves introducing a new airplane into the mature airline industry the Space Station is NASA's attempt to enable the commercialization of an infant industry. In high-speed travel, industry would recoup its investment through passenger ticket sales, transport revenues, etc. At present the Space Station is being built solely because the Federal government is paying for its construction and will continue to pay for its operations and maintenance. The Space Station is not a for-profit venture.

Mr. Goldin. I am not as concerned about the Space Station as the broad technology base of this Nation. I am very concerned about the stress on American corporations on near-term performance and their not being able to work on a cooperative basis on real high-risk, high-payoff and high technology. I have grave concerns about this area.

Mr. Walsh. We will be glad to share that with our other colleagues who have decisions to make about research funding.

Mr. Hobson.

Competitiveness in the Aeronautics Industry

Mr. Hobson. I was going to ask the question that Mr. Price asked because I think that is going to have a negative effect on the competitiveness in the aeronautics industry in this country. At some point I would like you to comment about that, the effect on our competitiveness as you look out into the future.

Mr. Goldin. I was in the private sector for 25 years, and up until 10 years ago when we restructured in America, corporations were able to fund things with a much longer time horizon on it. As we went through restructuring in the 1980s, that time horizon began getting shorter and shorter. We talk about research and development, but what we are really talking about in industry is product development and applied research, not the long-term, high-risk research.

I think there is great concern. I know Mr. Curt Weldon, who is very interested in this subject, is going to hold a conference in Philadelphia on it because of his concern about the long-term R&D investment, and I think this is a subject that is bigger than NASA, and we need to take a look at the relationships between the government and industry in this area of long-term, high-risk research. And if you take a look at the budgets in these areas for the long-term, high-risk research, the budgets are coming down, and most of the R&D money is going into near-term product development and applications.

During the cold war we had the strength of the defense budget, which was robust in this area, and the NASA budget funding this long-term, high-risk research, but today it is very stressful, and I wish I could give you obvious answers, but the alarm bells went off. And we don't have any ill feeling toward Boeing. In fact, Boeing did what it had to do, but the alarm bells went off, and our concern about long-term, high-risk partnership with industry needs to be reexplored.

Mr. Hobson. I worry about the European industry taking over the competitiveness. Do you think that they have the capability of stepping up?

Mr. Goldin. Not yet, but I will tell you the European research in aeronautics is high-quality research. It is really good. I am very impressed, especially by some of the efforts that I have seen in Germany and France and England. They do really good work in aeronautics. The Japanese are getting stronger also. And when the Russian economy returns, you know, even if it is 10 years from now, the Russians are very good in this area, too.

So this is an area that I think needs some time, and in the President's budget we wanted to make sure that at least we had a core effort in aeropropulsion, so we are proposing an ultra efficient engine program.

NASA's Management Skills

Mr. Hobson. That is my next question.

Before I get to that, I want to say to you that I think sometimes it is a little disheartening to come before these

committees. You are one of the few agencies in this entire government that has taken to heed the change in government. Most people come in here, and they are getting their budgets floated higher, bigger, but you are the one person that I think has brought outside management skills to an agency that we all expect perfection from. A lot of people were concerned about NASA's spending. You grappled with it, and you have continued to struggle with it, and I guess our job is to continue to poke at you to do even better. But I do want to commend you because of all of the agencies, and I sit on a number of different appropriations committees, you are the only one outside of the Department of Defense that has taken a real whack along the way.

Evolvable Expendable Launch Vehicles

Before I get into the UEET, can you tell a little bit about the Lockheed Martin engine deal with the Russians?

Mr. Goldin. I know that we purchased time on the Russian TU-144. Is that the program that you are talking about? Is it the EELV?

Mr. Hobson. Yes.

Mr. Goldin. Lockheed Martin Corporation made a decision. They took a look at all of the engines that exist in the world to power that vehicle, and they decided that the RD-180 engine built by the Russians was the most cost-effective, efficient engine in the world, and they are going to build their evolvable expendable launch vehicle based upon that technology, and Pratt Whitney is working with this Russian company so that technology will get transferred to the U.S. so we have a backup capability to build that engine in the U.S.

But the fact of the matter is, that is an incredible engine. The Russians are very good rocket engineers. I know that there was some concern of American technology going to Russia. Here is an example where we are buying Russian technology and bringing it to this country, and there is a lot of concern in Russia because Pratt Whitney will get transfer of that technology.

Docking System

Mr. Hobson. What about docking; didn't you buy a docking system from the Russians?

Mr. Goldin. Yes. We bought it for $25 million, and for us to develop it would have cost a quarter of a billion.

Mr. Hobson. I think there is a tendency to think that technology exchange is a one-way street. These are two examples of the U.S. working with Russia to develop technology more efficiently and at a lower cost, which is mutually beneficial.

Ultra Efficient Engine Technology (UEET)

I would like to turn to a question on the UEET program. As I understand it that this program was developed to respond to concerns about the growing amount of air traffic, new safety requirements and more stringent engine noise and emission standards. Given that NASA eliminated two other aeronautics

programs in the fiscal year 2000, does the new UEET program fully develop the technology base needed to regain America's role in aeronautics? And you indicate that the success of this program is contingent partnerships being able to transfer resulting technology. What are these partnerships, and how is NASA going to enhance them?

Mr. Goldin. Aeropropulsion is crucial to the future of aviation. In fact, I was with the GE people yesterday, and we showed them what we are doing in aeronautics. They said, do you understand what NASA has done over the last 10 or 20 years in developing aeropropulsion technologies? It has provided the basis for a lot of engines that GE is now selling competitively worldwide.

It is the intention of this ultra efficient engine technology program to make leap-frog changes in how we develop jet engines. At the present time jet engines are limited in their efficiency because they operate at 1,700 degrees, the melting point of alloys that we have. We are now looking at materials that operate at 2,000 and 3,000 and 4,000 degrees. If we can build combustion chambers based on ceramic matrix materials that can operate at those temperatures, the fuel consumption would go way down. From the military standpoint, you get longer range from your planes. From a commercial standpoint, fuel is a very big expense; and with less fuel, you have less emissions. So we think this is crucial to future directions.

At the same time other nations are developing low-noise technologies which are allowing them to cut the noise levels at airports so they can go sell their planes and their engines. Remember what I said, 75 percent of the engines now sold are to the commercial supplier, so it is crucial as a Nation that we develop the most efficient, quietest, cleanest engine, because if we don't do that, our people will not be keeping up with the other corporations. And I have to say that the Europeans are very, very good in this field. Rolls Royce builds the engines, and they do a very good job.

Collaboration Between NASA and Other Agencies

Mr. Hobson. Recently, I saw some reengined KC-135s at Mildenhall AFB. I asked to see the engine shop, but the engines are so reliable, there was no need to have that in-theater. It is unbelievable the reliability that is in these engines today.

This is a question about NASA and DOD which you and I have discussed before. Over the years I have pushed for cooperation and collaboration between NASA and other Federal agencies, and I think this is vital to ensure that taxpayers get the most bang for their buck without unnecessary duplication between the various agencies. You don't build weapons, I understand that, but in your budget you recognize NASA's supportive role in helping DOD to maintain our defense capabilities, specifically in the field of aeronautics.

Can you elaborate how this propulsion technology is going to assist DOD in its military aircraft? One effort which I mentioned in the past is the issue of aviation safety, and I notice in this year's budget you are introducing a new aviation safety program. Is this coordinated with DOD's current aviation

safety initiative, and can you also comment on other coordinated efforts between NASA and DOD?

Mr. Goldin. We are working with DOD. They have a program where they are making evolutionary upgrades to the jet engines to enhance the performance of the military planes. We would like to be able to take some of these new technologies and support them with revolutionary technology leaps because this is the area of NASA's strength, and the limitations on the defense budget don't give them the latitude to look at these revolutionary changes, and General Armstrong, who heads up the aerospace activity, is in the process of working with the DOD in this area.

With regards to safety, we have added an activity called synthetic vision, which will allow pilots to see on a flat panel display day/night, all weather. It would get us to the point where we can improve the safety of operations inzero/zero conditions. We feel this is essential for situational awareness of pilots. Whether you are piloting a military plane or a commercial plane, this is something that is essential technology, and clearly we are going to make this technology available to the DOD.

Last year you worked me over pretty good on some of the test facilities, and rightfully so. And we have been aggressively working with the DOD on doing propulsion testing. That was one of the areas of your concern, and we are really converging, and I believe both the Air Force and NASA will have better test programs as a result of this convergence.

Clearly the area of real intense cooperation is the Air Force is now actually putting money into NASA reusable launch vehicle programs, and I think that is a real testament to the support we have been giving them, and the deputy program manager of one of our new reusable launch vehicle programs is an Air Force officer. So we are now literally sending NASA employees over to the DOD to ensure this tech transfer, and they are sending employees over to NASA, and I said we are proud to have people walk around NASA in military uniforms.

AGING AIRCRAFT

Mr. Hobson. And you are also going to talk to DOD about the aging craft?

Mr. Goldin. Yes. I am going to be meeting with Secretary Peters, and we are going to talk about the aging aircraft studies that you recommended to us.

NASA AUDITING RUSSIAN FUNDS

Mr. Walsh. That completes our first round. We are scheduled to go to 12:30 and come back. We will try to keep it to 5 or 7 or 8 minutes, and everybody gets another crack. If not, we will just pick up where we left off. I am going to try to make these questions brief.

We have talked a lot about the U.S. money that has gone to Russia for the space program. Has NASA audited those funds, and what control mechanism does NASA have to ensure that the questions on the use of these funds can be answered?

Mr. Goldin. First let me say that we negotiate firm fixed-price contracts with the Russians with very specific, very

descriptive milestones that they have to meet, and we give them a distributed set of payments based upon completion of milestones. We have people in their plants in Russia. And relative to the audit, I would like Mal to answer that part of the question.

Mr. Peterson. The simplest form of an audit is to not pay until you take delivery of any goods or services, and what we do is we negotiate a value to us of a particular good or service that the Russians are going to furnish, and then we do not pay them until we have determined that they have satisfied that obligation. So that is our first and foremost line of defense.

The other is that we maintain a constant awareness of what is going on within their plants with our resident officials there so we can track progress and make sure if there are any concerns that the funding is flowing to the suppliers. Where there has been an issue with the supplier not delivering hardware because of not getting paid, we actually go to that supplier's plant and make sure that the funding is provided to the supplier so that the hardware can get delivered.

SOYUZ PURCHASE

Mr. Walsh. Let me latch onto that question. Your explanation of the best audit is one in which you pay after services have been rendered and a contract has been satisfied. The Soyuz purchase that we are talking about this year, the $100 million purchase of Soyuz and other additional equipment, my understanding is that will not be ready for 2 years, so how can we--maybe this is not your approach on this specific case, but if the best audit is one that you pay for services rendered and the contract is completed, satisfied, why are we spending $100 million on a Soyuz that won't be completed for 2 years?

Mr. Peterson. The hardware takes 2 years to build, that is certainly true. What you are doing is actually making progress payments. As you go through each step of the build process, you are making your payments based on milestone accomplishments, so you are tying it to actual progress.

Now, it turns out that for the Russians, in order to place the orders for that hardware, they have to go out and provide their suppliers with the money in order to build--their suppliers who work sort of on a don't trust, actually give us the money first, and then we will build it for you. So we go in and look at that delivery, make sure that the hardware has been ordered, that the work is in progress and then monitor the progress along the way.

Mr. Walsh. Last year we appropriated at least 60 million to the Russian Space Administration, I believe is the title. What did we get for that?

Mr. Goldin. We got a commitment for 4,000 on-orbit hours from Russian astronauts. They were initially going to be doing research for their activities. That in essence doubles the amount of astronaut time that we have for the early phases for the Space Station and allows us to do much more research.

Mr. Walsh. That is future, so we are not really getting a services rendered contract in that case?

Mr. Goldin. That is correct. And the other thing that we

obtained was storage space. We need additional storage space for some of the critical subsystems that we want to put on orbit in case we have problems, and we got, I think, 3 cubic meters of storage space committed on the service module once it is up there. So those are the two exchanges that we got, but they are in the future.

Mr. Walsh. That is a contractual agreement, is it not, for that space and that time?

Mr. Goldin. Yes.

Mr. Walsh. We have a signed document?

Mr. Peterson. The purpose for the $60 million was not--we secured a benefit to us for that. The other benefit, of course, was to have their service module schedule be maintained or actually put back on track. So we tied the milestones for the payment of that $60 million to specific items that the Russians had to put into place on that service module.

Mr. Walsh. That service module is still in doubt; is it not?

Mr. Goldin. We are getting much more confidence in it because we think that they are going to be ready to pack it up for shipment in about 2 weeks. If it does arrive down at Baikonur in the first or second week of May, we will be ready for a launch in the fall. But we have a written agreement for these hours and the storage space.

Mr. Walsh. On Mir you said if--I think Mr. Sununu asked or maybe it was Ms. Northup, I can't remember, if Mir stays up, is that a show of bad faith to the United States in this arrangement that we have? You suggested if they can keep it up there with private investors and service it without sacrificing servicing the space lab, that would be a goodthing, but you don't really believe that can happen, do you?

Mr. Goldin. I would say the probability of that happening is 1 in 10.

Mr. Walsh. That is a good short answer.

Mr. Goldin. I am trying, sir.

RELATIONSHIPS WITH STATE AND LOCAL GOVERNMENTS

Mr. Walsh. That was very helpful. It puts things in proportion.

NASA has obviously lots of spin-off benefits which we have been able to sell to the American public. One of those is, I believe, the technology in satellite imagery and the uses of that technology for local governments--local and State governments for land use planning and agriculture and flood control and so on.

How would you characterize NASA's relationship with State and local governments?

Mr. Goldin. I think it is good, but could be much better.

Mr. Walsh. How could we improve it?

Mr. Goldin. I think we need to reach out to local governments and State governments with the intensity that we have worked with the commercial sector. I don't think we are doing a good job. I haven't thought about it until now, but I would like to give you a thoughtful answer.

Ghassem, would you like to say something?

Dr. Asrar. We are in the process of establishing a dialogue

with all of the Governors of all of the States, and we are trying to identify what their needs are, and this would be the basis for formation of a solicitation later this year or early next year for expanding our relationships with the State and local governments.

Mr. Goldin. But still I am not satisfied. I know that we are doing a lot better with industry than we are with State and local governments. I will commit to you a thoughtful response to the record integrating what Ghassem said.

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

Mr. Walsh. I want to be realistic here. Your budget is going down. You have major challenges ahead of you. You have huge commitments, time commitments, space and energy and human commitments. But I would like to get your thoughts on how we can improve that situation down the road.

Mr. Mollohan.

INTELLIGENT SYNTHESIS ENVIRONMENT (ISE)

Mr. Mollohan. Thank you, Mr. Chairman.

Mr. Goldin, NASA has proposed a new Intelligent Systems program in the 2000 budget, but it doesn't seem to be located in any one place, and you have a Technology Investments pamphlet that contains an Intelligent Synthesis Environment program, which includes a 5-year projection for $180 million. I don't think that you speak to it in your written submission, at least I can't find it, but I understand that the new Technology Investments program includes $20 million in fiscal year 2000 for this Intelligent Synthesis Environment program. Could you tell the subcommittee a little about this new program? It is difficult to piece it together from your budget submission. What are the pieces to the initiative, and could you tell us a little bit about it?

Mr. Goldin. You find it in the aeronautics research and technology base under information technology. That is where you find it in the budget. But let me talk briefly about it.

One of the lessons that we learned from the International Space Station and a number of other programs is that we don't have adequate design tools, and, by the way, we have talked to many corporations on the subject. We would like to be able to simulate a spacecraft before we build one piece of hardware. We would like to be able to have globally distributed teams of scientists and engineers that would go into virtual space and spend their time on the creative process, not spending their time on all of the routine processes required with present information systems.

We think this is the single most important set of tools we can develop that will get us to a cycle time goal of a few years from the 5 years we are at right now. We also believe this is a critical tool for American industry also. And in developing these specific tools, we are going to be building test beds. We have $180 million planned over the next 5 years. We will begin to take the best tools available and train our people and integrate it into our basic design processes and

each year make progress on improved approaches.

Right now when we commit to a major program, we commit--when we have perhaps 10 or 20 percent detailed design knowledge, we commit 90 percent of the costs. In the long term, and I think this is a decadal goal, we would like to be able to have 70 or 80 percent design knowledge when we commit 90 percent of the cost. This is the fundamental problem of engineering today. This is not just true in government programs, these are true in commercial programs. These are the core technologies that we want to go into.

Mr. Mollohan. What centers are going to have the lead in this program?

Mr. Goldin. Intelligent Synthesis Environments will be led by the NASA Langley Center in Virginia, and the intelligent systems that form the intellectual basis for these tools will be led by the NASA Ames Center in Sunnyvale.

Mr. Mollohan. What is the requested funding level for the fiscal year 2000?

Mr. Peterson. You are asking about for the ISE, sir?

Mr. Mollohan. It is hard for us to break it out, but yes, if you can give us that, and then if there are any other pieces in the budget request that relate to this program?

Mr. Peterson. Well, the specific request for the ISE is augmentation of $20 million, and that, of course, is located in that information technology element of the R&T base in aeronautics.

The other parts of the intelligent systems world are in our core technology spending that is located in the Space Science budget.

Then there are a significant number of corollary activities, the high-performance computing, which is distributed not only within the Aeronautics budget as a separate program, but is also found in both Earth and Space sciences. There are a number of related activities that are secondary contributing factors. I would be glad to provide you with a breakdown of how we distribute our spending both specific on this case and the related.

Mr. Mollohan. Would you, please?

Mr. Goldin. Yes, we will do that.

[The information follows:]

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

OMB REQUEST FOR ISE

Mr. Mollohan. What was your request to the OMB for the ISE initiative?

Mr. Peterson. It was for $60 million. We received $20 million of that.

Mr. Mollohan. But still your 5-year projection was 180 million? That wasn't affected by OMB?

Mr. Peterson. Our 5-year projection to OMB was 300----

Mr. Walsh. I just realized I made a mistake. This was scheduled to end at noon. I have a 12:00 appointment that I am going to be late for. Would you fellows mind if we came back at 1:30? Do you want to finish up, Alan? I wasn't watching my

schedule as closely as perhaps I should, and I apologize.

Mr. Mollohan. That is fine.

Mr. Walsh. Why don't we break here then. Again, I apologize for the confusion, and we will reassemble at 1:30. Thank you.

AEROSPACE TECHNOLOGY PROGRAM

Mr. Walsh. The subcommittee hearing will come to order.

We were ending up the morning session with Mr. Mollohan asking questions and we will go back to him. Welcome back, Mr. Goldin, and all of your staff.

Mr. Mollohan. Thank you, Mr. Chairman.

Mr. Goldin, I'd like to follow up on some of the questions exploring the cuts in science and aeronautics particularly targeted at the aerospace technology program. I was listening to your questions with interest and thought I heard you saying that perhaps you were in the process of reevaluating these proposed cuts because of some perhaps push-back you had possibly gotten from industry or concerns about the effects of those cuts on America's commercial aerospace and commercial airline industry.

Did I hear you perhaps laying a foundation for a reconsideration of the cuts proposed?

Mr. Goldin. I wasn't at that point yet. We are taking a look at our overall strategy with how we deal with the aeronautical sector of the American business community. We had been working mainly with the air frame manufacturers and the engine manufacturers and the first and second tier parts suppliers.

As part of that reevaluation, we are now exploring working more directly with the people who use them rather than those who build them to be sure that we have the right set of requirements.

Mr. Mollohan. Is that reevaluation in response to the reaction that you received from this industry to your proposed cuts to the aerospace technology programs?

Mr. Goldin. No, it was in reaction to the dilemma that Boeing found itself in.

Mr. Mollohan. That is why you proposed the cuts?

Mr. Goldin. Right.

Mr. Mollohan. Are your recommendations for a $330 million reduction in that area a result of Boeing's problems, or an effort to meet a budget target and this was just a place that you felt came out at the lowest priority?

Mr. Goldin. The first cause of the problem we had was the dilemma that Boeing found itself in in not being able to solve its near term problems and fund the long term solution. That is real. Once we saw that was the issue and we cancelled the program, clearly we had a need for additional monies in the International Space Station and that is where we put the money. There was the initial cause and we utilized it.

We then recognized that we couldn't completely take all of the money we had out of the aeronautics program so we put back into the program, in working with the OMB, $50 million for the ultra efficient engine program and----

Mr. Mollohan. And the safety program?

Mr. Goldin [continuing]. $10 million a year for the safety

program and some money in for the revolutionary concepts activity, and then ISE. So we took some out and put some back in recognizing that we couldn't take the full amount out.

INCREASING AEROSPACE FUNDING

Mr. Mollohan. What I am trying to ask is: are you, in the answers to these questions, telegraphing an interest in coming back to the committee and working with the committee as the year progresses, and perhaps increasing the funding above your budget request in the aerospace line item?

Mr. Goldin. I believe that is the case. We are concerned that we might be below critical funding levels, yes. You have perceived that correctly.

Mr. Mollohan. If you do come back, how would your request be different and how would you recommend that the dollars be spent differently than your current budget submission recommends?

Mr. Goldin. Right now we believe we have core money in there to keep the NASA workforce intact at the Glenn Center and at Langley. We are concerned that the engine companies who have been putting in a considerable amount of their own money and have that money to expend--we may not have enough money to cost share with them. That is one of the areas we are very concerned about. United Technologies, Pratt Whitney, and GE, are having discussions with our people about the potential investment that they would like to make in this ultra efficient engine. They are talking about putting in their own money. We would like to have the matching funds so we do the right thing, but we haven't had those complete discussions yet.

And we are a little bit concerned that we may have cut too closely on some of the noise activities that we had been working on. Those are two areas that come to mind right now.

Mr. Mollohan. I don't think I am going to ask the question of you think the money is going to come from right now. I am going to wait until the process unfolds a little bit.

Mr. Goldin. Thank you.

RUSSIA'S PERFORMANCE FAILURES

Mr. Mollohan. If I may ask this question, Mr. Chairman, in closing up this round, there were a lot of questions in the first round about the quality of Russian performance with regard to their role in the Space Station.

In the face of all of the disappointments associated with their performance failures--coming through with the funding commitments and timeliness of delivering on their various commitments--when all of that is said and done and you get to the bottom line, how do you evaluate the importance of the Russian participation in the Space Station from this point forward to the success of the program, specifically, and the other issues that surround the involvement, the national security issues, the policy issues that surround the value of the Russian participation in the Space Station?

Mr. Goldin. I would like to----

Mr. Mollohan. A bottom line answer.

Mr. Goldin. Bottom line, if I had it to do over again and

the President asked me to ask the Russians, in knowing what I know today, I would still do it. It is absolutely clear that the Russians knew so much more than we did about having astronauts in space for decades. We had flown the Shuttle and we have only had experiences of a couple of weeks at a time. The experience that the Russians had in training, operations, logistics, building hardware, the experience they had in dealing with the contingencies and emergencies, the experience with protecting lives and safety, has been an invaluable experience and I don't believe we could have built the Space Station.

In this morning's session we talked about we didn't save the money that we thought that we would save, but I will contend that had we not worked with the Russians, had we not done Shuttle-Mir, had the Russians not been gracious enough to tell us about extended duration space flight, I don't know that we could have built the Space Station on schedule, and the potential for overrun and management problems would have been enormous. There is no doubt in my mind from a technical standpoint, I am not even getting into the politics, from a technical standpoint we needed the Russians.

In modern America it is difficult because many of us have not recovered from the relationship we had during the Cold War, but the bottom line, it was clearly the right thing to do.

I would like to add two other things to that. First, we negotiated with the Russians that they would take down their independent national space station which they operated without any other country for 20 years. They have signed up to that. The head of the Russian Space Agency signed that protocol. That in and of itself is a statement from the Russian side that they trust America. Keep in mind this is a U.S. led Space Station and it is not a sovereign national program, so they have made a step in our direction and I think that is a step of a true partnership.

Now there are a couple of issues and the road is a little bumpy, but in the end I think they are going to deorbit that Space Station. That is a tremendous trust that they are putting in America.

I come back to the issue of backup launch. We as a Nation mourned, as we had to keep the Shuttle down for 2 years after Challenger. If the Shuttle goes down, we will not be able to keep that Space Station up there and it will be essential to have these backup Russian resources. If we were to sever relationships with the Russians now, and we will not have the 3 or 4 years necessary to build the backup propulsion module and the crew return vehicle, I don't think that we could keep the Space Station that we have up in the sky right now. So bottom line, if we had it to do over again, I would say do it over again.

The one issue that I would have done differently and I accept responsibility and accountability for it, I would have pushed harder, even though the budget was tight, to start some of these contingency activities 3-4 years ago. That is one issue that NASA and Dan Goldin should have done better.

Mr. Mollohan. Thank you.

Mr. Walsh. Mr. Knollenberg.

POLITICIZING OF SCIENCE

Mr. Knollenberg. Thank you, Mr. Chairman, and welcome, Mr. Goldin. It is good to see you and everybody here.

One of my biggest concerns I think is not NASA, but it is the politicizing of science, and I want to talk to you a little bit about how that may or may not be a problem with NASA. I want to get your read on some of the things that bother me. There are times when Members of Congress, perhaps agencies use science to--use in fact manipulation of science to fulfill a political agenda, and I believe that we should rely upon sound science and I trust that NASA does. I am appreciative of the record that NASA has in terms of producing what appears to me to be sound independent science.

But let me then proceed into an area of climate change that has to do with some of the work that NASA does. I think there is about 1.6 billion that is devoted to Earth science. I don't know how that is sorted out, but I am just reading from the page here. There was a bump of some--about 47 million in that category, but let me get into some of the questions.

Mr. Goldin. Sure.

Mr. Knollenberg. Maybe just briefly and I don't need much on this, but what does NASA do to assure us that there is objectivity and independence in coming to their conclusions with respect to the agency's science?

Mr. Goldin. First, we are strong adherents of the peer review process. It is very, very important to us. In fact, if you look in the Earth science area, NASA's mission is to supply basic science without injecting policy into the output of the science, especially in the area of global climate change. We fund researchers for the peer review process that are both sides of the issue. As an example, there is Dr. Hansen at the Goddard Institute in New York who is feeling that there is significant climate change induced by human behavior. And then there is Spencer and Christy at NASA Marshall down in Huntsville, Alabama. We fund them both. We do not want to prejudge the results of what is going to come out, but we want that debate to take place in the open scientific arena.

One other example, we have some researchers at NASA Johnson who believe that they found samples of microbial life in a martian rock. I encouraged them to publish their results and I also encouraged other researchers to compete for pieces of that rock so they could do their own research and have an open debate. Today there are scientific meetings that are set up to deal with do we believe there is fossilized microbial life in that rock or not. The key thing for NASA to do is to fund the science and not to get into policy; and we try very, very hard to do that.

Mr. Knollenberg. As you well know, this issue is being discussed here in Congress, not as much as I would like but it will be soon, and I want to take science out of politics as best we can and make sure that the scientists, the real experts do it. And I am glad to hear that you have point/counterpoint already in your agency. My question is: The additional money this year that goes into Earth science, and I am estimating, 47 million, that is an increase. I know in many cases it is down. Your various categories of expenditures are down. That one went

up. Where is the 47 million being spent and how much of that might be spent in the area of analysis of greenhouse gases and their impact on the Earth's climate?

Dr. Asrar. I will explain that.

Mr. Knollenberg. I want to know what the justification is.

Dr. Asrar. Most of the added funds are going towards our applications and commercial remote sensing activities. Plus the analysis of data from those missions that have about 10 missions to launch this year, and we thought that we have to add more money into the analysis of data resulting from these missions to fully realize their potential.

Mr. Knollenberg. When do you expect to be done?

Dr. Asrar. With what aspect?

Mr. Knollenberg. You mention that you have a series of missions?

Dr. Asrar. Ten of them are being launched this year and 26 total over the next 5 years. In anticipation of this great volume of data resulting from these missions, we wanted to make sure that there is a robust and healthy basis forutilizing the data from these missions. Plus as I stated, we are putting an added emphasis on applications of the data resulting from these missions toward solving practical societal problems.

Mr. Knollenberg. I would assume that the work that you do, the analysis that you do, and specifically the money that goes into these missions, is that in any way being done elsewhere? Is this a totally compartmentalized effort?

Dr. Asrar. The scientific objectives that we pursue are the national scientific priorities identified through the National Research Council.

Mr. Knollenberg. What about the U.S. Global Change Research Program?

Dr. Asrar. We do work through that forum in some of the scientific objectives that we pursue.

Mr. Knollenberg. Would you say that your work, your scrutiny and observation has more to do with outer space? When I say outer space, I guess I am talking about the area, the arena in which you find yourself that you are in, I guess that is outer space?

Dr. Asrar. Yes. Our unique contribution is providing that unique vantage point from space. That is what we bring to the table in the form of remote sensing of the entire Earth system, for example oceanography or looking at the vegetation over the surface of the Earth or the atmosphere itself, both the chemistry and physics of the atmosphere.

COMMUNICATE FINDINGS WITH OTHER AGENCIES

Mr. Knollenberg. How do you communicate your findings with other agencies?

Dr. Asrar. Through coordinating mechanisms such as U.S. Global Change Research Program, which is multiagency. We also have agency-to-agency arrangements. For example, we do work very closely with FEMA, Federal Emergency Management Agency, in extending the benefit of what we do to actual practical applications that FEMA requires.

Mr. Knollenberg. What about EPA?

Dr. Asrar. EPA we only have some limited work on the aspect

of land cover, land use change in the U.S., which is very limited. That pertains to the global and carbon cycle and land cover, land use change.

RESEARCHING CLIMATE CHANGE

Mr. Knollenberg. I am looking for your comment here because it appears to me that NASA has a unique role when it comes to researching climate change, a kind of reserve for that upper atmosphere or beyond the atmosphere. And there is a statement that I wanted to relate to you that appears in one of the science publications which has to do with the same folks, the U.S. Global Change Research Program. It has to do with why climate models can't keep up, and you may have seen this. It seems that the thrust of this article or criticism is that the U.S. models can't keep up. We have to in some cases--American analysts have to rely on other countries to get the kind of detailed data that they need.

Is that statement correct that appears in this publication?

Dr. Asrar. Partially the statement is correct. Within the U.S. we still continue to provide the scientific leadership towards developing these models and understanding the fundamental chemistry, physics and biology that analyze the phenomenon of the Earth and its climate. What we haven't done a good job of is integrating the outcome of that research into a series of operational models that we can use by operational agencies such as National Oceanic and Atmospheric Administration. That is one aspect that is missing.

The second aspect that is missing, our ability in the area of high end computing capabilities has eroded in the past few years so that we cannot improve--we are not keeping up with the developments across the globe in terms of being able to have higher computing capability to improve the resolution of these models so that they continue to capture smaller events at local to regional level so we can extend the benefit of the global science to the local.

Mr. Knollenberg. How much of NASA's studies is based on absolute evidence?

Dr. Asrar. Most of what we do is based on the actual observations, but to bring out the full benefit of those observations, we couple them with the modeling effort. So it is really observations and modeling, but the unique contribution of NASA at the 80 percent plus or close to 90 percent is in the form of observations, the actual evidence. We do have some modeling data, but it is very minimal compared to some other agencies.

EFFECTS OF GREENHOUSE GASES

Mr. Knollenberg. Let me come back, do current satellites have the capacity, the capability, to measure the effect of greenhouse gases in the clouds? I don't mean outer space but back on Earth. Do you have anything to relate to that?

Dr. Asrar. Only the upper atmosphere, the stratospheric component, the issues associated with ozone and the chemical constituencies that contribute to the ozone depletion.

Coming down to the troposphere where we live, we currently

do not have any capabilities in space that allows us to measure those gases directly. However, we do have some space-based capabilities to assess the strength of the pools or the sinks for these gases, primarily the ocean, which takes up the CO2 and the forests in the research mode, not in the operational mode.

Mr. Knollenberg. How long has NASA been measuring the globe's temperature as it relates to climate change from the satellites?

Dr. Asrar. Basically NASA helped NOAA to have that capability in place since we have put in place the weather system. So we currently do not have any research satellites. We rely heavily on the operational monitoring satellites for that purpose. That is part of the reason for this controversy because those satellites were not intended to provide highly accurate precise measurements, and we are extending their use to some objectives that they were not intended for.

But the earliest we can have such a well-calibrated mission launch would be the end of next year, that measures the temperature of the atmosphere precisely to about to 1 degree Kelvin in slabs of 1 kilometer.

Mr. Knollenberg. Are there new technologies being utilized?

Dr. Asrar. That is the role that NASA plays, to shed some light on the scientific issues that are being discussed or studied at the moment.

Mr. Knollenberg. Thank you. Mr. Chairman, thank you.

Mr. Walsh. Mr. Cramer.

LIFE AND MICROGRAVITY SCIENCES

Mr. Cramer. Mr. Goldin, I want to bring you back to life and microgravity science and try to extend some of the conversations that we were having this morning in part 1.

There is a $15 million budget item that was to have been reserved for life and microgravity science that is now kind of lost in this discussion, or can you help me understand where it is and what it might be used for?

Mr. Goldin. Yes. In fact, this committee had suggested that NASA take a look at a standby mission in case we had delays in the Space Station building, and they put $15 million in the budget to get such a mission started. We took a look at it and we found that a standby mission in and of itself didn't make sense in that we could only get about 1,300 pounds of equipment up at a relatively high expense where typically we take 7,500 to 8,000 pounds of equipment up. There was a factor of 5 ratio in the real utility of that mission.

We said maybe we should consider a dedicated mission, and we do believe that a dedicated mission does make sense, but the $15 million only gets us part of the way there because to just pay for the rental of this equipment, which we would rent from the SpaceHab Company, would require an additional 15 to 25 million to get the double module that they have, and then we need another $84 million in expendables to have the Shuttle mission. So we are off by about $110 million. So that is the only reason that we are not at the present time scheduling such a mission.

We are going to try to move along the path that if the

money became available we could have such a mission, and we are looking at a time frame of early 2002 as a place that the manifest would allow such a mission. But absent that $110 million, we don't know how to do this dedicated mission. So we agree with the concept that the committee had when we started and just shifted it from a dedicated to a standby mission. But it is the absence of additional money that precludes us from doing it.

Mr. Cramer. So to spend this $15 million which OMB has concerns about now, we would have to come up with this additional amount for this now different mission that you are talking about?

Mr. Goldin. A dedicated mission, and we are about $110 million away from having the capacity to do that mission.

Mr. Cramer. Is there payload room on the October Hubble repair mission?

Mr. Goldin. No.

NASA'S ROLE IN EDUCATION

Mr. Cramer. I want to switch now to NASA and NASA's role in education.

There is a lot of debate going on about what we can do to strengthen elementary and middle school education over science and math issues, and even senior high school education. Is NASA doing enough to reach elementary and middle school students, our next generation of engineers and scientists, and do you have any programs on the books that would address this issue?

Mr. Goldin. We have a number of programs; and are we doing enough? No. Could we do more? Yes. Is this an area that I personally am frustrated with? Absolutely.

We have a way of reaching children with the space program that no other organization in the country could use. We have a number of programs where we train teachers, I think we touch some 20,000 teachers a year. We do everything from giving scholarships where they will come to our facilities for a few weeks to a whole summer to learn how to do a better job of teaching. We touch 3 million children a year through a whole range of programs that we have, and they are very effective.

The dilemma is the continued compression on the budget, and this is an area where we would love to do more. We think that we can have a very major impact. And when I get a chance to talk to teachers--I spend a lot of time going and talking to schools, and I see the direct impacts we have, especially on disadvantaged children which have a problem relating to math and science, and on young girls that don't always get that extra push to look at math and science. And this is an area where we would love to do more, but we are limited by the capacity.

Mr. Cramer. Is there a consolidated program out of headquarters that is carried on through all of the centers?

Mr. Goldin. Each of our centers works on it. I can give you a few facts. We have 151 programs. They are spread across our 10 centers, so there is a broad range of activity.

Mr. Cramer. That you would call educational activities?

Mr. Goldin. Yes.

Mr. Cramer. Which partner you with the private sector?

Mr. Goldin. The private sector sponsors a van that we take around the country, and in this van teachers can upload CD-ROMs and get videos and lesson plans. It will pull up to a school and teachers use it for a day or two, and then it is on to the next city. A number of the aerospace companies sponsor that van and cost share it with NASA.

Mr. Cramer. And I would assume in my community with my NASA center there at Marshall there are such programs that are in my district.

Mr. Goldin. Yes.

Mr. Cramer. I would like more information about that because in my community we have a unique opportunity with the presence of private sector companies like InnoGraph and others to partner with schools, adopt individual schools. There is a new science center that is going up there, and we may be able to broaden our impact with limited dollars on teachers and consequently young people.

Mr. Goldin. American students are doing terrible in testing when compared to students in other countries. Math aptitude is very low, especially among eighth graders, and we are going to have a society in the next few decades that are going to be totally dependent on technology, and if we want to lead the world in the 21st century, this is what we need to do.

I will point out that the NASA budget even in education is not at the expectations we would like to have. Even though the NASA budget came down over the last 7 years, the education budget has gone up. We have disproportionately increased it, but we can't keep on doing that given the fact that the budget keeps coming down.

Mr. Cramer. The President's fiscal year 2000 budget included increases in research and development funding for DOE, the National Science Foundation and EPA, several other departments and agencies, but NASA's R&D budget will actually suffer a 4 percent decrease. Do you believe that NASA is being adequately funded in the area of research and development?

Mr. Goldin. NASA is better.

Mr. Cramer. In what sense?

Mr. Goldin. I guess the President is confident that we will do more with less.

Mr. Cramer. Do you think that you can?

Mr. Goldin. We would not object to an increase in our budget. We might even smile a little.

TOTAL COST BUDGETING

Mr. Cramer. Talk to me a little bit about your full cost practices that were initiated in 1995, the multiyear initiative to introduce full costs practices into NASA.Where are we with that now?

Mr. Goldin. We would like NASA to operate just like a private business. When I arrived at NASA, our people were working real hard but they didn't know what their overhead costs were, what their general expenses were, and it would always be cheaper to do it in-house than to have a contractor outside the agency.

So we wanted to better manage the costs, and you need to understand the bases for those costs, not just the direct

charges but the indirect charges. One of the reasons that American industry has been so productive in the last decade, they have gone after the overhead costs. Total cost management says that we will be able to break out the NASA costs completely, understanding all of the overhead that goes along with it, so that our center directors can do a much better job in how they manage the taxpayers' resources.

We are planning on doing total cost budgeting for the fiscal year 2001 process and by fiscal year 2002 we hope to be implementing total cost management.

Mr. Cramer. Agencywide?

Mr. Goldin. Agencywide. Let me just double-check with our CFO. Arnold?

Mr. Holz. That is correct.

Mr. Goldin. I believe we will be one of the first agencies in government to undertake this. When we do this, I ask the Congress to have a certain level of understanding because you are going to have a full level of detail from NASA, and it will be very easy to go in and say, gee whiz, look at all of this waste. We are going to have sunshine on it and we are going to want to work with you on it.

One of the dilemmas that we have in implementing total cost management is if we have too many accounts in our management and appropriations and not have the flexibility to move between accounts, we may not be able to implement total cost management.

For example, even though NASA Marshall doesn't play a major role in some of the space science areas, a lot of the space science projects come to NASA Marshall for specific support. Now if under total cost management we can't move people back and forth between centers and utilize the facilities at NASA Marshall, it will put a chilling effect on the ability of other centers to use NASA Marshall in the space science area.

So one of the areas that we have really made a plea for is to not put up too many barriers in the terms of appropriations accounts. We have the operating plan that allows the Congress to have total oversight in how we move the money around. If we have too much inflexibility, we may not be able to give you and ourselves the opportunity to understand how to get our overhead costs down even more.

Mr. Cramer. It has to be agencywide or it is a contradiction or there is going to be some domino that is going to stop.

Mr. Goldin. By the way, my employees will be very unhappy with me because I told them to trust everybody and be very open. And if the first reaction to total cost budgeting, management and accounting is to come in and start punishing people for laying things down to the table openly like they do in industry, it is not going to work. In industry you get rewarded for identification of overhead problems.

Mr. Cramer. We in the Alabama congressional delegation have held your feet to the fire with what has been going on or has not been going on at the Marshall Space Flight Center, and you have done a terrific job of making sure that we settle things down there, that we understood the future that will exist for the Marshall Space Flight Center. Art is doing a terrific job. The NASA community seems to be responding to him very, very

well. The reorganization that has occurred there, the way that the employees have realigned that I was apprehensive about at first because change is tough for a lot of people, specifically where they are required to work and who they are required to work with, but that has gone very, very well. So I think we as one space center representing the space family that we are so proud of appreciate what you have done there.

Thank you very much, Mr. Chairman.

Mr. Goldin. May I just note that Art Stephenson is who you are referring to. He left the private sector at a tremendous financial disadvantage because he is a patriot.

Mr. Cramer. We were anxious about him because he was from Texas, and so we were a little anxious. I personally was not, but I knew the community would be anxious. They would interpret here come the Johnson folks again. But Art Stephenson is doing a terrific job. Thank you.

Thank you, Mr. Chairman.

BUDGETARY CONSTRAINTS--SCIENCE MISSIONS

Mr. Walsh. I would like to stay with this science mission issue for a minute, if I may.

You are saying that it is not going to happen because of budgetary constraints; is that correct?

Mr. Goldin. I'm sorry?

Mr. Walsh. The idea of putting on an additional science mission because of budgetary constraints?

Mr. Goldin. The dilemma is we don't have the additional 15 to $25 million required to fund the activity through Space Hab and the additional $84 million to pay for the expendable parts necessary to have this launch on the Shuttle. Those are our two problems.

HUBBLE AND TRIANA MISSIONS

Mr. Walsh. Did you opt to do the Hubble and the Triana mission in terms of priorities, putting them above this?

Mr. Goldin. We felt that in the case of the research mission, we had about 60 percent of the research covered because we added extra lockers to the Shuttle. This happened after the request that you had made of us to do more research and to the express racks that we were going to put on the Space Station.

In the case of Hubble we thought that was a higher priority because the Hubble is one of the most productive scientific instruments we have and that we wouldn't have the threat of losing the spacecraft, but we were afraid that we would lose a significant flow of science and so we prioritized that above it.

In the case of Triana, we believe that Triana is a very crucial mission to get us to the L-1 point, and it is a secondary payload so we don't have to pay for the actual launch itself, and that Triana we believe has the potential in the future of perhaps replacing five geostationary satellites, three of which the United States owns, two of which we depend on other countries, with perhaps just two satellites at the L-1 and L-2 points. We think that it has a real potential.

On top of that, we think that it is going to fill in some gaps in our scientific knowledge. There we would get zero without Triana.

In the case of this scientific microgravity and lifescience research, we are getting 60 percent of what we did in the prior 4 years.

Mr. Walsh. Were you surprised when you found that in the budget deal last fall?

Mr. Goldin. No.

Mr. Walsh. The Triana mission? That was--as I understand it, that was included in the Omnibus Budget Reconciliation Act at the end of last year; is that correct?

Mr. Goldin. I think we submitted it as an operating plan.

Mr. Walsh. Were you surprised?

Mr. Goldin. I was pleased.

Mr. Walsh. And surprised?

Mr. Goldin. No, I was pleased.

SHUTTLE MISSIONS

Mr. Walsh. Will you not save money in terms of Shuttle missions that could be used on a science mission because of delays with the service module?

Mr. Goldin. It is not that we save money. Every time a Shuttle goes up, the marginal cost for that flight is $84 million. So if we don't fly a mission this year, the mission is still scheduled and we still have to do it. And at some point down the line you will have to find that $84 million if you add in an additional mission, and that is the dilemma that we have.

Mr. Walsh. What if Congress encouraged you to do that sooner than later in the event that you get behind on these other missions and we try to make that whole in the next budget?

Mr. Goldin. If we knew that the money would get paid back, I believe it would give us a lot better ability to go do such a mission. Let me talk to my comptroller, who is having an anxiety attack. He agrees with me. It is okay. He works for me and he agrees with me. But I would say if we can have some agreement with the administration and the Congress that we could get the money paid back in the future, I think we could go ahead and do such a mission.

HUBBLE SPACE TELESCOPE MISSION

Mr. Walsh. Did you work that kind of a deal for the Hubble mission?

Mr. Goldin. Right now my instructions for the Hubble mission are to go find the money and to----

Mr. Walsh. That is the kind of deal you worked, it sounds like.

Mr. Goldin. We are going to look to see what we will not do or cancel to do that Hubble mission. We are not being given a promise that we will have money in the outyears. It is a very tough issue, and I have asked Ed Weiler, who is the Administrator for the Space Science Enterprise, to start prioritizing his activity, and I have asked Joe Rothenberg to do the same thing.

Mr. Walsh. How will you reprogram that $15 million if you don't spend it for that mission?

Mr. Goldin. If we do not spend it, it is not appropriated and it does not belong to us. You told us to do it, and so we would look to your guidance and direction. No one is going to spend that money without your giving us direction.

CENTER VISITS

Mr. Walsh. We have asked you some hard questions. Let me throw you a softball.

Mr. Goldin. Thank you.

Mr. Walsh. I am new to this chairmanship. I have been on the subcommittee, and I have a lot to learn about your business. If you were to suggest some things to see and places to go for myself and the subcommittee to get a better handle on what NASA does generally and specifically and also in relation to the Space Station, what would you suggest?

Mr. Goldin. If you could afford a two-day trip, it has been very valuable, we have done this with other Members, I would go to NASA Johnson, NASA Marshall and NASA Kennedy. Those are the 3 places where the lion's share of that work gets done. To see the hardware, to see the people, to get a chance in an informal setting to ask deep penetrating questions, I believe would be the best way you could come up to speed the fastest. And we could do it in a two-day period. If you do that with the committee, I would personally like to come along on such a trip.

Mr. Walsh. We will see if we can work it out.

I think Mr. Knollenberg is next.

Y2K COMPLIANCE

Mr. Knollenberg. Thank you, Mr. Chairman.

I understand that this may not have been asked this morning. It is the Y2K question. Has that come up?

Mr. Goldin. It has not.

Mr. Knollenberg. Well, I have to ask a question about it. As it applies, I suspect that if Y2K compliance were going to occur anywhere, it would probably occur in outer space first, perhaps. Maybe that is saying a little bit too much, but I have reason to believe that--every reason to hope that NASA's Y2K problem is not a problem. And I guess I would like some assurance from you as to what the status of the issue is and while we are talking about that, I guess you ought to reflect on Russia's situation, too. And whether that is in some kind of awkward--it might become an awkward marriage due to that problem.

Mr. Goldin. First, let me say that we are on track by the end of March to have our modifications and tests done of our Y2K issues. But we are not going to stop there. We are going to be running a whole series of end-to-end tests in 12 different areas. We have already run some end-to-end tests with our partners in Russia. I met with the leadership of all of the partner agencies on the International Space Station and discussed with them the fact that we expect them to be Y2K compliant. The Russians are implementing a plan, and it looks

like they will be on target to do that. But to check that we are correct, we are going to run an end-to-end test between Mission Control Houston and Mission Control Moscow.

I believe we will be successful with the Russians, the Europeans, the Japanese and the Canadians.

The one area that gives me concern because we don't have a complete contingency plan worked out is the infrastructure support like power and communications, not just in Russia but in the United States. And what we are doing at our NASA centers is we have a set of criteria where we are asking our people to guarantee if you lose power from the local power company, I believe they have to go for so many days, so we will be putting in motor generator sets, and we are looking at alternate communications channels in case the communications channels break down.

We have a set of criteria in this area. I have asked Joe Rothenberg how to back up the Russians in case their communications or power systems go down. So we are not stopping at the borders, we are looking at the broad system integrations and doing end-to-end tests to validate it.

Mr. Knollenberg. What about other countries?

Mr. Goldin. We are working with all of the partners that we have. I sent out 3,000 letters to all of our sub tier suppliers telling them about our expectations on Y2K compliance. So we are trying to spread the net not just beyond what we control, but we are trying to go over the interfaces.

Mr. Walsh. You may want to ask questions of Roberta Gross, who is the Inspector General, who is here today, who has done some audits of Y2K with the different centers.

RUSSIANS IN THE SPACE PROGRAM

Mr. Knollenberg. I will be happy to do that. I want to ask a couple of questions. That might eat up my time, and if I have time, I will be more than happy to get into that.

I want to come back to a question about a subject you and I had about a matter a year ago and we discussed in particular the Russians and the safety features of the space work, and you shared with me what was kind of an eye opener in that the Russians seem to do a better job than we might have expected when it comes to space. I questioned you about why don't they seem to have that same quality when it comes to some of the things on Earth, such as their whole business with the nuclear waste problem, et cetera, et cetera.

And I think you answered then that you are aware but did not know. Have you come to any further knowledge or any further information that might help tell us why they are so good, so thorough, so great about outer space, but they don't do so well at home?

Mr. Goldin. I am going to leave that to Secretary Richardson at Energy. I just don't know enough about the subject, and I am very concerned that with my inadequate knowledge I may be saying something inappropriate.

Mr. Knollenberg. But you still feel very good about what takes place with the Russians in the space program?

Mr. Goldin. To date they have done a superb job. One more example that I would like to give you, Vladimir Titov, who flew

on the Shuttle twice, was on top of the Proton rocket that blew up underneath him. They had such a good safety escape system that he walked away from a Proton rocket with all of its fuel blowing up on the launch pad.

Today we do not have such a similar escape system in our own Shuttle. I know that the Russians are very conscientious, and I have to say to date in what they do in space, and so far we have seen they seem to be very, very much on top of it. So I will stick with that and not take myself into other areas I am not an expert in.

SHUTTLE COST

Mr. Knollenberg. I noticed by the chart that the Shuttle costs are coming down. I suspect that you have an expectancy of that continuing on into the future. This chart gives us some indication of what has taken place in the last several years since 1993?

Mr. Goldin. Yes.

Mr. Knollenberg. And I suspect that you are looking for greater reduction in addition to what is here. What about the current fleet of our four space shuttles? They wear out, too. This may have been asked previously and if it has been, I apologize.

Mr. Goldin. No, it has not.

Mr. Knollenberg. At what point do they become hazardous to the passengers?

Mr. Goldin. The shuttles were designed for 400 trips to and from space. We rated them at only a hundred trips to and from space, and they are at about 25 percent of that derated design life taken in average. We have had about a hundred flights, four shuttles on average. They are about 25 percent into their design life.

The issue is not the shuttles wearing out, the issue is obsolescence of parts and subsystems and components, and this is a focus of NASA and the United Space Alliance, and one of the areas that we are going to have to make some additional investments in the years ahead to keep the Shuttle safe is to avoid the problems associated with obsolescence and to incorporate advanced technologies to make the Shuttle even safer than it is today and I anticipate the expenditure of additional funds to increase the 4 to $500 million a year we spend in Shuttle upgrades and continue to make the Shuttle safer.

Mr. Knollenberg. Is that reflected in your projection of expenditures?

Mr. Goldin. We have about $400 million in Shuttle upgrade money now. And as part of the 2001 budget process, we are going to take a look at what additional upgrades we need to make to the Shuttle. But I would like to say openly and publicly, one of the reasons that we hired the United Space Alliance, we want to turn the Shuttle over to the private sector, and we expect them to make the Shuttle safer with higher quality, shorter turnaround time at lower cost.

Mr. Knollenberg. Do you have anybody yet?

Mr. Goldin. Yes, the United Space Alliance. We have had about $200 million since the contract began. But that is not

enough. I want more.

LAUNCH VEHICLES

Mr. Knollenberg. This is a softball type question too, but within the HEDS program or the--what is called HEDS, there is a statement that the major goals, of which there are four, are to increase human knowledge of nature's processes using the space environment; number two, explore the solar system. This next one, achieve routine space travel, does that fit into the way out there, 20, 30, 40 years from now or does that fit into this program, the privatizing?

Mr. Goldin. That is a key part. And the other part is the part that Mr. Cramer asked me about before and that is revolutionary approaches to launch vehicles that go well beyond the Shuttle, and in that next 20-year period we hope to bring in a number of new launch vehicles that will be competitive with the Shuttle. We are not going to arbitrarily shut down the Shuttle. We think that we are making great strides in making it safer, and we like the competitive marketplace to take part. And by having NASA not own the Shuttle, having a private corporation, it sharpens that competition, which I think is the strength of our economy.

CONTINGENCY PLAN FOR THE SPACE STATION

Mr. Knollenberg. Thank you very much.

Mr. Walsh. I would like go out of order on this Y2K question because Joe raised it. It is an issue and the two principals are here. Let me ask, the NASA Inspector General released a report last week that is critical of your agency--of your contingency planning for the Space Station. The report concluded that the contingency plan does not comply with NASA procedures and guidelines because management has decided to omit year 2000 computer issues and planned actions to prevent further Russian delays from the detailed contingency plan. Do you care to comment?

Mr. Goldin. I would like to ask Joe Rothenberg to answer that.

Mr. Rothenberg. Let me start with reiterating Mr. Goldin's statement. We do have a comprehensive test plan that is in place now that will demonstrate our readiness, including the Russian partners, to deal with the year 2000.

The second part of it is that there are a number of issues relative to things like power and communications. We are looking at portable satellite phones and things like that as backup. We have people who are currently doing an audit of what the Russian capabilities are at the mission control center at Moscow, which is the most critical facility because that is providing command and control for the first two elements up there.

At this point we still don't have a report back to say what kind of backup they have and what kind of capability they have to ensure that they have power to their control center in the event of industrial outages due to year 2000. The second thing is voice communication links back and forth. We expect to hear a report on the 9th of April at the general design review.

Mr. Walsh. Do you contest this report that the Inspector General has made that NASA does not comply?

Mr. Rothenberg. At the current moment my information says we will comply and we need to complete some testing and also evaluation of the backup facilities.

Mr. Walsh. Would the Inspector General care to respond?

Ms. Gross. We evaluate at a point in time and what Joe is describing is some plan for the future. It is not there at this time, and we will follow up the backup contingency plans that he is describing. Like I say, it is a snapshot in time. We do not have those reports that he was talking about. We will only follow up an audit.

Mr. Walsh. Should we be concerned?

Ms. Gross. You have an International Space Station. NASA has to make sure that it has contingency plans. That is why we did the audit. We said you need to follow up. That is why Mr. Rothenberg is also taking the steps to find out what contingency plans are there.

Mr. Goldin. That was precisely why I asked Mr. Rothenberg about 3 months ago to take a look at the backup situation that the Russians had and not just rely upon the Russians solving their Y2K, but in the event that the Russian power system and the phones were down, in a similar fashion to what we are doing even at our own centers in the United States. Until he finishes that study, we will not be compliant with the comment that the IG made on the report.

Mr. Walsh. Thank you.

Mr. Mollohan.

ENVIRONMENTAL RESEARCH AIRCRAFT AND SENSOR TECHNOLOGY (ERAST) PROGRAM

Mr. Mollohan. Thank you, Mr. Chairman.

Mr. Goldin, I would like to ask you a couple questions about the unmanned aerial vehicle program or the Environmental Research Aircraft and Sensor Technology program, ERAST. Could you give us a status report on this program, what you have achieved, and what you feel is left to be done in the short term--and I am interested in the long-term plans for the program as well?

Mr. Goldin. Yes. We felt that there was an area in the development of these remotely piloted vehicles that was not being looked at. This is the low cost end and so we undertook this ERAST program to build the vehicles and the sensors. Mr. Knollenberg asked questions about understanding the atmosphere, not just looking down from space. We felt that we needed to make some measurements in the upper atmosphere, and so we started a program to look at reciprocating engine technology and solar power technology, and in both of those areas we have made record breaking flights and we have done it with very, very low costs by working in partnership with industry.

The area of the consumables or reciprocating engines, we think that work will be concluded in 1 to 2 years. There will be vehicles available that could be then commercialized and NASA could use them to make environmental measurements at about the 60,000 foot range.

We are also developing a very efficient solar powered aircraft that could stay up indefinitely at altitudes of 80,000

feet and the key technology there is energy storage to have ultra lightweight energy storage systems. We think that will be available in 3 years and our goal is to have a plane that could go up for a half year at a time and operate at 60 to 80,000 feet and take hundreds of pounds of payload. That we think will be a very major breakthrough and we intend to spend about $20 million a year to develop this technology and we hope that it will be available commercially in 3 to 5 years. These technologies are helping us to build planes to fly on Mars because the martian atmosphere is the equivalent of 100,000 feet and having this experience in these very thin atmospheres is going to be very useful in helping us fly this plane on Mars.

Mr. Mollohan. I bet the companies wish that was a market available today.

Mr. Goldin. We are getting interest from a lot of communication companies. They told us if we could have such a plane available, it could open up a whole new capability in mobile communications.

Mr. Mollohan. The solar plane?

Mr. Goldin. The solar plane. The key is getting a plane that could stay up there indefinitely because when the planes have to go up and down, you have to buy more of them.

Mr. Mollohan. Are these two different planes? You sound like you are describing the solar plane for the 80,000 feet missions, but do you see solar planes fulfilling the 60,000 feet missions as well?

Mr. Goldin. They may. The planes that carry consumables and have reciprocating engines could take a bigger payload, and they will be used in different applications. You have to build a pretty big wing to get a few hundred pounds, and the planes that operate at 60,000 feet today could take 500 pounds, and that may be a more attractive payload for certain applications. It depends on what you want to use it for.

Mr. Mollohan. NASA is committed to developing both technologies and capabilities?

Mr. Goldin. That is correct. We believe in another year or two we will have demonstrated the capability of these reciprocating engine planes. I think it will take a few extra years to get the solar plane developed.

Mr. Mollohan. Two years to get the reciprocating engine planes approved?

Mr. Goldin. A year or two.

Mr. Mollohan. Do you want to check that?

Mr. Goldin. A year or two is right. We have another year or two worth of development on the reciprocating engines.

RECIPROCATING ENGINE PROGRAM

Mr. Mollohan. What are the list of challenges with regard to the reciprocating engine program?

Mr. Goldin. Sam, I need a little help.

Mr. Venneri. Good afternoon. The challenges on the reciprocating engine programs, and the Department of Defense also has some interest in that regime of being able to flyand so we are going to cooperate with the DOD.

Mr. Mollohan. Are they participating in ERAST?

Mr. Venneri. No, but they are parallel in many ways so we understand their progress. The challenges are in lightweight materials, autonomous flight. They are not really breakthrough kinds of things. That is why we say between the DOD effort and our effort, within a year or two we will reach that point in time where we will have a capability that several different organizations or industry could use.

Mr. Mollohan. So the current team that is involved in the reciprocating engine project, you think it would take a year or two more of testing and refinement in order to prove or to develop a successful model?

Mr. Venneri. If we are talking about time. Not in the fiscal year 2000 budget, that is correct.

Mr. Mollohan. Yes, that is what I am talking about.

And so, in this budget, what commitment to that part of the ERAST program is requested?

Mr. Venneri. Well, we have one line in there and that is $20 million and exactly the breakout between the high flyer and the sustainable 65,000, I would have to look that up. There is a division between those two efforts.

Mr. Mollohan. But you do have a commitment to proving out that technology?

Mr. Venneri. We do have a commitment to follow through on the Alliance promise, yes.

[The information follows:]

Reciprocating Engine Program

With regards to the ERAST program objectives, the most significant remaining challenges are in two areas: (i) demonstrated operational flight reliability and maintainability for deployment to remote locations; and (ii) enabling technologies for operations in unrestricted air space. This latter element applies equally to consumable fuel and solar powered aircraft. The ERAST Alliance will utilize reciprocating engine UAV's (uncrewed aerial vehicles) for this development, since the technology readiness of these platforms is much further developed than the solar platforms.

The FY-00 budget allocated to meet these commitments will depend largely upon flight test results from the three ERAST consumable fuel UAV's during the Spring and Summer of 1999. In any event, the funded technology developments will comprise incremental improvements to the existing ERAST engines. There are no plans for any significant modifications or upgrades to these existing ERAST engines, nor for a totally new reciprocating engine development program. This would require substantial amounts of additional funding, which alone would easily exceed the total ERAST budget.

Mr. Mollohan. Thank you.

Thank you, Mr. Chairman.

Mr. Walsh. Mr. Frelinghuysen.

MIR SPACE WALKS

Mr. Frelinghuysen. Thank you, Mr. Chairman. I apologize for my absence.

I just wanted to ask Mr. Goldin about this little article news brief in Space News. You know it is Space News when the news is dated March 29, 1999. They seem to project themselves. Maybe we ought to question the accuracy of this little comment with the headline, Cash Shortage Prompts Cut in Mir Space Walks. ``Financial shortages have forced Mir's Flight Control Center to cut the number of space walks planned by the Russian station's current crew from 5 to 2, officials say. The lack of finances has played a major role in our decision two walks would be enough.''

Victor Blanov, Deputy Chief of Flight Control, told Space News, ``Two space walks are planned for April and July,'' he said, ``and will carry out additional space walks if the Russian space researchers raise enough cash to send more equipment to be installed in Mir's exterior in the next few months.'' It doesn't sound that this program is about to be deorbited or am I misreading?

Mr. Goldin. I told the chairman----

Mr. Frelinghuysen. Did something occur in my absence?

Mr. Goldin. The chairman asked me what I thought was the probability Mir would stay up in the air, and I said 1 in 10; unless there is someone who is willing to come up with a quarter of a billion dollars a year to commercially finance the Mir Space Station, I don't believe it will be up in the sky after August of this year.

Mr. Frelinghuysen. So all of the talks, certainly they are having a financial crisis, it doesn't mean that this Mir will have a life much longer than you have projected?

Mr. Goldin. Unless there is commercial--someone who wants to bring commercial money to the Mir, I don't believe that it will be up in the sky beyond August of this year.

GAO REPORT

Mr. Frelinghuysen. Thank you. Shifting gears a little bit, Mr. Hobson and I last year had a number of questions and you gave us quite lengthy responses on that GAO report that was critical of NASA and the Department of Defense, critical in the sense that there was--they underlined the point that there were a lot of duplicative efforts. We heard a few minutes ago, and I didn't catch the name of the gentleman who was sitting to your right, but the DOD has one program and you have one program. In his words, similar but separate programs, which sort of gets to the gist of my question, and maybe my understanding of what we said was inaccurate.

What are you doing relative to working on this problem, if there is a problem between DOD and NASA?

Mr. Goldin. I don't believe that there is a problem. In fact I think the relationship with the Department of Defense and NASA has not been better. In fact, we are taking the responsibility in a multibillion dollar activity we have of developing reusable technology for civil, commercial and defense space. And in fact the DOD joined with us in a program called Future X. They are spending additional monies that they have to make sure that that program is successful. They expect that that program will lead to what they describe to be a space maneuvering vehicle.

LAUNCH VEHICLES

Mr. Frelinghuysen. What about the use of launch facilities? Do you have separate launch facilities?

Mr. Goldin. We have launch facilities associated with reusables, i.e., the Shuttle. We launch all of our rockets from--expendable rockets from DOD facilities. We do not have any unique launch facilities for expendable rockets. We use their facilities.

Mr. Frelinghuysen. They are not separate?

Mr. Goldin. No.

PRIVATIZATION OF THE INTERNATIONAL SPACE STATION

Mr. Frelinghuysen. Recently I was visited by what I classify as a pro space organization which, among other things, advocated for the privatization of the International Space Station. I know that you have testified some this morning and you have testified in the past that you supportthis privatization goal. Has NASA developed a conceptual plan?

Mr. Goldin. Yes, we have. We have provided copies of that plan to the Congress. I have just asked someone to leave industry and come and be my special assistant for commercialization, Mr. Daniel Tam. He just left the private sector, as with Art Stephenson, at a great financial sacrifice. He was doing acquisitions for TRW and he has come to NASA to help us in our commercialization. We are going to be talking to a variety of companies. We have some pathfinder companies that are planning on using the Space Station for commercial activities and we are exploring the possibility of running an open competition to have a nongovernment organization run the science utilization activities on the Space Station.

So we want to do everything possible, but what we don't want to do is pretend that it is privatization by having companies do 100 percent of their business with NASA and calling it commercial. We would like to amortize the overhead costs across the government and the private sector, and that is the direction that I am going to drive in.

SPACE STATION OPERATING COST

Mr. Frelinghuysen. Review the estimated costs to operate the Space Station, annual costs?

Mr. Goldin. $1.3 billion a year is our present estimate.

Mr. Frelinghuysen. You may have been asked this, is it realistic to believe that private enterprise can operate such--can handle these types of expenses?

Mr. Goldin. Well, we have set aside up to 30 percent of the utilization facilities on the Space Station to private enterprise, and we said if they can go up to 50 percent we will make it available. We are going to see what is possible.

I think the biggest single barrier to commercial is not the operation on the Space Station but the $10,000 a pound to get it up to orbit. That to me is the biggest problem that we face, not just for the Space Station but we face this for commercial, military and civil space. This is why we have such an

aggressive program to try and get the costs of launch down, and that will be the enabler in my mind of commercial operation in the broadest sense.

And we hope in 10-15 years NASA will be able to move at a lower orbit if we achieve some of the goals and access to lower orbit.

ENGINE TESTING

Mr. Frelinghuysen. Mr. Goldin, I understand that you have begun the testing of the engines that will be used in the X-34 vehicle. Can you tell me how that test is going?

Mr. Goldin. A hundred percent successful. We are now ready for the full certification and qualifications tests. We will be testing eight engines. Three have been delivered, and we will be ready for testing. So we will be on track.

X-33 PROGRAM

Mr. Frelinghuysen. What is the next milestone for the X-33 program?

Mr. Goldin. To resolve the issue on the composite tanks. The rest of the vehicle has come together. The launch pad is complete. In fact, I might point out that what used to cost hundreds of millions of dollars was done for $32 million. We have a complete launch complex out in the Mohave Desert at Edwards Air Force Base. As soon as we can resolve the problems we are having in building these huge composite tanks, I think the last of our problems will be behind us on the X-33 and we will be readying it for launch.

Mr. Frelinghuysen. It is my understanding that NASA is currently pursuing a lightweight synthetic aperture radar which would be developed in a cost shared agreement with industry. What will this effort cost your agency?

Mr. Goldin. Mal, can you give me that number.

Mr. Peterson. Just a second.

Mr. Goldin. I think it is $120 million.

Mr. Frelinghuysen. He knows his stuff.

Mr. Peterson. That is correct.

Mr. Frelinghuysen. Mr. Chairman, make a note, another positive mark. Thank you, Mr. Chairman.

Mr. Walsh. I along with everyone else in the room duly noted that.

Let's see. Does anyone else have any--Joe, do you have any questions that you need to ask?

Mr. Knollenberg. No. I just want to reserve the right to submit some questions for the record.

Mr. Walsh. I think we are in agreement that we have exhausted at least the verbal questions, although you are still going strong, and we will submit some questions for the record.

Mr. Frelinghuysen. He is still in orbit.

Mr. Goldin. I wish I were.

Mr. Walsh. I think we will leave it right there and submit questions for the record and hope that you would respond back quickly. Do you have any closing remarks?

ADMINISTRATOR GOLDIN'S CLOSING REMARKS

Mr. Goldin. Yes. There are two issues. One, I wanted to verify some numbers about the testing that the Russians had done. You said how many tests had they done and how many were accepted.

As of--and this is on the service module. As of the 15th of March, they had completed 445 tests of 526 and 411 were accepted.

Mr. Walsh. You said that they did 500 out of 570.

Mr. Goldin. I was giving some verbal information. That is why I said as of 3-15. The verbal information is that the number of tests increased to 570, of which they completed 500, and about 540 were accepted, but that is verbal information and that will not be verified until another 24 hours. I wanted to be correct on that.

Another item, there was a question that you asked me that I was confused on and I wanted to verify over lunch, and the question was regarding the growth on the Space Station, how could we categorize the costs.

Through development complete, the estimate is $22.1 million. If we put in a 1-year schedule margin it is 23.7 million. Of the growth, overrun is about 900 million. Additional scope, namely a crew return vehicle and building additional equipment to compensate for what we were concerned the Russians might not be able to deliver, the total of that is 2 billion. And the schedule ranges from 1.7 billion--schedule slip, 1.7 billion if we hold the present schedule. If we put in the 1-year reserve, it is 3.3 billion, and I felt that I should verbally tell you that and I apologize for my confusion.

Mr. Walsh. That is all right.

We had scheduled a hearing for tomorrow also and I don't think that we will need to do that, so you are free to go. Thank you.

Mr. Goldin. Thank you.

Mr. Walsh. The hearing is closed.

[GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT]

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